PROJECT MANUAL
FOR THE CONSTRUCTION OF

SRE BUILDING EXPANSION

GERALD R. FORD INTERNATIONAL AIRPORT
GRAND RAPIDS, MI 49512

GRR: C-378
DLZ: 2241.7462.00
C&S: K19.012.001
PBA: 2022.0215

SEPTEMBER 18, 2023

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Section 10 Definition of Terms

When the following terms are used in these specifications, in the contract, or in any documents or other instruments pertaining to construction where these specifications govern, the intent and meaning shall be defined as follows:

Paragraph Number	Term	Definition
10-01	**AASHTO**	The American Association of State Highway and Transportation Officials.
10-02	**Access Road**	The right-of-way, the roadway and all improvements constructed thereon connecting the airport to a public roadway.
10-03	**Advertisement**	A public announcement, as required by local law, inviting bids for work to be performed and materials to be furnished.
10-04	**Airport**	Airport means an area of land or water which is used or intended to be used for the landing and takeoff of aircraft; an appurtenant area used or intended to be used for airport buildings or other airport facilities or rights of way; airport buildings and facilities located in any of these areas, and a heliport.
10-05	**Airport Improvement Program (AIP)**	A grant-in-aid program, administered by the Federal Aviation Administration (FAA).
10-06	**Air Operations Area (AOA)**	The term air operations area (AOA) shall mean any area of the airport used or intended to be used for the landing, takeoff, or surface maneuvering of aircraft. An air operation area shall include such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway, or apron.
10-07	**Apron**	Area where aircraft are parked, unloaded or loaded, fueled and/or serviced.
10-08	**ASTM International (ASTM)**	Formerly known as the American Society for Testing and Materials (ASTM).
10-09	**Award**	The Owner’s notice to the successful bidder of the acceptance of the submitted bid.
10-10	**Bidder**	Any individual, partnership, firm, or corporation, acting directly or through a duly authorized representative, who submits a proposal for the work contemplated.

Paragraph Number	Term	Definition
10-11	**Building Area**	An area on the airport to be used, considered, or intended to be used for airport buildings or other airport facilities or rights-of-way together with all airport buildings and facilities located thereon.
10-12	**Calendar Day**	Every day shown on the calendar.
10-13	**Certificate of Analysis (COA)**	The COA is the manufacturer's Certificate of Compliance (COC) including all applicable test results required by the specifications.
10-14	**Certificate of Compliance (COC)**	The manufacturer's certification stating that materials or assemblies furnished fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer's authorized representative.
10-15	**Change Order**	A written order to the Contractor covering changes in the plans, specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for work within the scope of the contract and necessary to complete the project.
10-16	**Contract**	A written agreement between the Owner and the Contractor that establishes the obligations of the parties including but not limited to performance of work, furnishing of labor, equipment and materials and the basis of payment. The awarded contract includes but may not be limited to: Advertisement, Contract form, Proposal, Performance bond, payment bond, General provisions, certifications and representations, Technical Specifications, Plans, Supplemental Provisions, standards incorporated by reference and issued addenda.
10-17	**Contract Item (Pay Item)**	A specific unit of work for which a price is provided in the contract.
10-18	**Contract Time**	The number of calendar days or working days, stated in the proposal, allowed for completion of the contract, including authorized time extensions. If a calendar date of completion is stated in the proposal, in lieu of a number of calendar or working days, the contract shall be completed by that date.
10-19	**Contractor**	The individual, partnership, firm, or corporation primarily liable for the acceptable performance of the work contracted and for the payment of all legal debts pertaining to the work who acts directly or through lawful agents or employees to complete the contract work.
10-20	**Contractors Quality Control (QC) Facilities**	The Contractor's QC facilities in accordance with the Contractor Quality Control Program (CQCP).

Paragraph Number	Term	Definition
10-21	**Contractor Quality Control Program (CQCP)**	Details the methods and procedures that will be taken to assure that all materials and completed construction required by the contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors.
10-22	**Control Strip**	A demonstration by the Contractor that the materials, equipment, and construction processes results in a product meeting the requirements of the specification.
10-23	**Construction Safety and Phasing Plan (CSPP)**	The overall plan for safety and phasing of a construction project developed by the airport operator, or developed by the airport operator's consultant and approved by the airport operator. It is included in the invitation for bids and becomes part of the project specifications.
10-24	**Drainage System**	The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area.
10-25	**Engineer**	The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for engineering, of the contract work and acting directly or through an authorized representative.
10-26	**Equipment**	All machinery, together with the necessary supplies for upkeep and maintenance; and all tools and apparatus necessary for the proper construction and acceptable completion of the work.
10-27	**Extra Work**	An item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, but which is found by the Owner's Engineer or Resident Project Representative (RPR) to be necessary to complete the work within the intended scope of the contract as previously modified.
10-28	**FAA**	The Federal Aviation Administration. When used to designate a person, FAA shall mean the Administrator or their duly authorized representative.
10-29	**Federal Specifications**	The federal specifications and standards, commercial item descriptions, and supplements, amendments, and indices prepared and issued by the General Services Administration.

Paragraph Number	Term	Definition
10-30	**Force Account**	**a.** Contract Force Account - A method of payment that addresses extra work performed by the Contractor on a time and material basis. **b.** Owner Force Account - Work performed for the project by the Owner's employees.
10-31	**Intention of Terms**	Whenever, in these specifications or on the plans, the words "directed," "required," "permitted," "ordered," "designated," "prescribed," or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer and/or Resident Project Representative (RPR) is intended; and similarly, the words "approved," "acceptable," "satisfactory," or words of like import, shall mean approved by, or acceptable to, or satisfactory to the Engineer and/or RPR, subject in each case to the final determination of the Owner. Any reference to a specific requirement of a numbered paragraph of the contract specifications or a cited standard shall be interpreted to include all general requirements of the entire section, specification item, or cited standard that may be pertinent to such specific reference.
10-32	**Lighting**	A system of fixtures providing or controlling the light sources used on or near the airport or within the airport buildings. The field lighting includes all luminous signals, markers, floodlights, and illuminating devices used on or near the airport or to aid in the operation of aircraft landing at, taking off from, or taxiing on the airport surface.
10-33	**Major and Minor Contract Items**	A major contract item shall be any item that is listed in the proposal, the total cost of which is equal to or greater than 20% of the total amount of the award contract. All other items shall be considered minor contract items.
10-34	**Materials**	Any substance specified for use in the construction of the contract work.
10-35	**Modification of Standards (MOS)**	Any deviation from standard specifications applicable to material and construction methods in accordance with FAA Order 5300.1.
10-36	**Notice to Proceed (NTP)**	A written notice to the Contractor to begin the actual contract work on a previously agreed to date. If applicable, the Notice to Proceed shall state the date on which the contract time begins.

Paragraph Number	Term	Definition
10-37	**Owner**	The term "Owner" shall mean the party of the first part or the contracting agency signatory to the contract. Where the term "Owner" is capitalized in this document, it shall mean airport Sponsor only. The Owner for this project is .
10-38	**Passenger Facility Charge (PFC)**	Per 14 Code of Federal Regulations (CFR) Part 158 and 49 United States Code (USC) § 40117, a PFC is a charge imposed by a public agency on passengers enplaned at a commercial service airport it controls.
10-39	**Pavement Structure**	The combined surface course, base course(s), and subbase course(s), if any, considere4d as a single unit.
10-40	**Payment bond**	The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will pay in full all bills and accounts for materials and labor used in the construction of the work.
10-41	**Performance bond**	The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will complete the work in accordance with the terms of the contract.
10-42	**Plans**	The official drawings or exact reproductions which show the location, character, dimensions and details of the airport and the work to be done and which are to be considered as a part of the contract, supplementary to the specifications. Plans may also be referred to as 'contract drawings.'
10-43	**Project**	The agreed scope of work for accomplishing specific airport development with respect to a particular airport.
10-44	**Proposal**	The written offer of the bidder (when submitted on the approved proposal form) to perform the contemplated work and furnish the necessary materials in accordance with the provisions of the plans and specifications.
10-45	**Proposal guaranty**	The security furnished with a proposal to guarantee that the bidder will enter into a contract if their own proposal is accepted by the Owner.
10-46	**Quality Assurance (QA)**	Owner's responsibility to assure that construction work completed complies with specifications for payment.
10-47	**Quality Control (QC)**	Contractor's responsibility to control material(s) and construction processes to complete construction in accordance with project specifications.

Paragraph Number	Term	Definition
10-48	**Quality Assurance (QA) Inspector**	An authorized representative of the Engineer and/or Resident Project Representative (RPR) assigned to make all necessary inspections, observations, tests, and/or observation of tests of the work performed or being performed, or of the materials furnished or being furnished by the Contractor.
10-49	**Quality Assurance (QA) Laboratory**	The official quality assurance testing laboratories of the Owner or such other laboratories as may be designated by the Engineer or RPR. May also be referred to as Engineer's, Owner's, or QA Laboratory.
10-50	**Resident Project Representative (RPR)**	The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for all necessary inspections, observations, tests, and/or observations of tests of the contract work performed or being performed, or of the materials furnished or being furnished by the Contractor, and acting directly or through an authorized representative.
10-51	**Runway**	The area on the airport prepared for the landing and takeoff of aircraft.
10-52	**Runway Safety Area (RSA)**	A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft. See the construction safety and phasing plan (CSPP) for limits of the RSA.
10-53	**Safety Plan Compliance Document (SPCD)**	Details how the Contractor will comply with the CSPP.
10-54	**Specifications**	A part of the contract containing the written directions and requirements for completing the contract work. Standards for specifying materials or testing which are cited in the contract specifications by reference shall have the same force and effect as if included in the contract physically.
10-55	**Sponsor**	A Sponsor is defined in 49 USC § 47102(24) as a public agency that submits to the FAA for an AIP grant; or a private Owner of a public-use airport that submits to the FAA an application for an AIP grant for the airport.
10-56	**Structures**	Airport facilities such as bridges; culverts; catch basins, inlets, retaining walls, cribbing; storm and sanitary sewer lines; water lines; underdrains; electrical ducts, manholes, handholes, lighting fixtures and bases; transformers; navigational aids; buildings; vaults; and, other manmade features of the airport that may be encountered in the work and not otherwise classified herein.
10-57	**Subgrade**	The soil that forms the pavement foundation.

Paragraph Number	Term	Definition
10-58	**Superintendent**	The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instructions from the RPR, and who shall supervise and direct the construction.
10-59	**Supplemental Agreement**	A written agreement between the Contractor and the Owner that establishes the basis of payment and contract time adjustment, if any, for the work affected by the supplemental agreement. A supplemental agreement is required if: (1) in scope work would increase or decrease the total amount of the awarded contract by more than 25%: (2) in scope work would increase or decrease the total of any major contract item by more than 25%; (3) work that is not within the scope of the originally awarded contract; or (4) adding or deleting of a major contract item.
10-60	**Surety**	The corporation, partnership, or individual, other than the Contractor, executing payment or performance bonds that are furnished to the Owner by the Contractor.
10-61	**Taxilane**	A taxiway designed for low speed movement of aircraft between aircraft parking areas and terminal areas.
10-62	**Taxiway**	The portion of the air operations area of an airport that has been designated by competent airport authority for movement of aircraft to and from the airport's runways, aircraft parking areas, and terminal areas.
10-63	**Taxiway/Taxilane Safety Area (TSA)**	A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft. See the construction safety and phasing plan (CSPP) for limits of the TSA.
10-64	**Work**	The furnishing of all labor, materials, tools, equipment, and incidentals necessary or convenient to the Contractor's performance of all duties and obligations imposed by the contract, plans, and specifications.
10-65	**Working day**	A working day shall be any day other than a legal holiday, Saturday, or Sunday on which the normal working forces of the Contractor may proceed with regular work for at least six (6) hours toward completion of the contract. When work is suspended for causes beyond the Contractor's control, it will not be counted as a working day. Saturdays, Sundays and holidays on which the Contractor's forces engage in regular work will be considered as working days.
10-66	**Owner Defined terms**	The following terms are included in this contract:
	Contract Drawings	Plans.

Paragraph Number	Term	Definition
	Subcontractor	The subcontractor refers any individual, firm, or corporation to whom the contractor, with approval of the Owner, sublets any part of work.
	Time and Materials Work	An item or items of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, but which is found by the Engineer to be necessary to complete the work within the intended scope of the contract as previously modified and an agreed price cannot be agreed upon. The Contractor shall perform this work and the Owner agrees to pay the Contractor based upon the work performed by the Contractor's employees and subcontractors, and for materials and equipment used in the construction (along with the Contractor's allowed overhead and profit).

END OF SECTION 10

Section 20 Proposal Requirements and Conditions

20-01 Advertisement (Notice to Bidders). See the Advertisement located in the front of these Contract Documents.

20-02 Qualification of bidders. Each bidder shall submit evidence of competency and evidence of financial responsibility to perform the work to the Owner at the time of bid opening. Within one week of receiving a written request, the bidder shall submit the requirements of this section to the Owner.

Evidence of competency, unless otherwise specified, shall consist of statements covering the bidder's past experience on similar work, and a list of equipment and a list of key personnel that would be available for the work.

Each bidder shall furnish the Owner satisfactory evidence of their financial responsibility. Evidence of financial responsibility, unless otherwise specified, shall consist of a confidential statement or report of the bidder's financial resources and liabilities as of the last calendar year or the bidder's last fiscal year. Such statements or reports shall be certified by a public accountant. At the time of submitting such financial statements or reports, the bidder shall further certify whether their financial responsibility is approximately the same as stated or reported by the public accountant. If the bidder's financial responsibility has changed, the bidder shall qualify the public accountant's statement or report to reflect the bidder's true financial condition at the time such qualified statement or report is submitted to the Owner.

In addition, each bidder who receives a written request shall furnish the following to the Owner:

a. A list of the categories of work to be performed by the bidder's work force and a list of work to be subcontracted out (See Section 80-01).

b. A list of construction projects completed in the past five years. The list shall include the project name, completion date, total contract value, value of bidder's portion of the work, engineer and owner contact information (names and phone numbers).

c. A list of construction projects in progress and under contract including the project name, percent complete, estimated completion date, total contract value, value of bidder's portion of the work, engineer and owner contact information (names and phone numbers).

d. A Schedule of Values showing the following information:

    1. For each lump sum bid item: Provide a breakdown of values for major products, assemblies or operations, indicating separate amounts for (a) purchased materials, (b) labor, and (c) construction equipment, which total to the lump sum price bid for each item.

    2. For each unit price bid item: Provide a breakdown of values for the unit price allocated to (a) purchased materials, (b) labor, and (c) construction equipment which total to the unit price bid for each item.

    The Schedule of Values will be reviewed by the Engineer. Any additional detail or justification for cost distribution shall be provided by the apparent low bidder upon

request. The Schedule of Values shall serve as a basis for computing progress payments during construction for installed portions of lump sum items, and to assist the Engineer in determining if change order costs are reasonable.

Unless otherwise specified, a bidder may submit evidence that they are prequalified with the State Highway Division and are on the current "bidder's list" of the state in which the proposed work is located. Evidence of State Highway Division prequalification may be submitted as evidence of financial responsibility in lieu of the certified statements or reports specified above.

20-03 Contents of proposal forms. The Owner's proposal forms state the location and description of the proposed construction; the place, date, and time of opening of the proposals; and the estimated quantities of the various items of work to be performed and materials to be furnished for which unit bid prices are asked. The proposal form states the time in which the work must be completed, and the amount of the proposal guaranty that must accompany the proposal. The Owner will accept only those Proposals properly executed on physical forms or electronic forms provided by the Owner. Bidder actions that may cause the Owner to deem a proposal irregular are given in paragraph 20-09 *Irregular proposals*.

Mobilization, if included in this proposal, is specified in Item C-105.

A prebid conference is required on this project to discuss as a minimum, the following items: material requirements; submittals; Quality Control/Quality Assurance requirements; the construction safety and phasing plan including airport access and staging areas; and unique airfield paving construction requirements. The location, date and time are stated in the Advertisement.

20-04 Issuance of proposal forms. The Owner reserves the right to refuse to issue a proposal form to a prospective bidder if the bidder is in default for any of the following reasons:

a. Failure to comply with any prequalification regulations of the Owner, if such regulations are cited, or otherwise included, in the proposal as a requirement for bidding.

b. Failure to pay, or satisfactorily settle, all bills due for labor and materials on former contracts in force with the Owner at the time the Owner issues the proposal to a prospective bidder.

c. Documented record of Contractor default under previous contracts with the Owner.

d. Documented record of unsatisfactory work on previous contracts with the Owner.

20-05 Interpretation of estimated proposal quantities. An estimate of quantities of work to be done and materials to be furnished under these specifications is given in the proposal. It is the result of careful calculations and is believed to be correct. It is given only as a basis for comparison of proposals and the award of the contract. The Owner does not expressly, or by implication, agree that the actual quantities involved will correspond exactly therewith; nor shall the bidder plead misunderstanding or deception because of such estimates of quantities, or of the character, location, or other conditions pertaining to the work. Payment to the Contractor will be made only for the actual quantities of work performed or materials furnished in accordance with the plans and specifications. It is understood that the quantities may be increased or decreased as provided in the Section 40, paragraph 40-02, Alteration of Work and Quantities, without in any way invalidating the unit bid prices.

20-06 Examination of plans, specifications, and site. The bidder is expected to carefully examine the site of the proposed work, the proposal, plans, specifications, and contract forms. Bidders shall satisfy themselves to the character, quality, and quantities of work to be performed, materials to be furnished, and to the requirements of the proposed contract. The submission of a proposal shall be prima facie evidence that the bidder has made such examination and is satisfied to the conditions to be encountered in performing the work and the requirements of the proposed contract, plans, and specifications.

Boring logs and other records of subsurface investigations and tests are available for inspection of bidders. It is understood and agreed that such subsurface information, whether included in the plans, specifications, or otherwise made available to the bidder, was obtained and is intended for the Owner's design and estimating purposes only. Such information has been made available for the convenience of all bidders. It is further understood and agreed that each bidder is solely responsible for all assumptions, deductions, or conclusions which the bidder may make or obtain from their own examination of the boring logs and other records of subsurface investigations and tests that are furnished by the Owner.

20-07 Preparation of proposal. The bidder shall submit their proposal on the forms furnished by the Owner. All blank spaces in the proposal forms, unless explicitly stated otherwise, must be correctly filled in where indicated for each and every item for which a quantity is given. The bidder shall state the price (written in ink or typed) both in words and numerals which they propose for each pay item furnished in the proposal. In case of conflict between words and numerals, the words, unless obviously incorrect, shall govern.

Prices should be written in whole dollars and cents. The extended total amount of each item should not be rounded.

The bidder shall correctly sign the proposal in ink. If the proposal is made by an individual, their name and post office address must be shown. If made by a partnership, the name and post office address of each member of the partnership must be shown. If made by a corporation, the person signing the proposal shall give the name of the state where the corporation was chartered and the name, titles, and business address of the president, secretary, and the treasurer. Anyone signing a proposal as an agent shall file evidence of their authority to do so and that the signature is binding upon the firm or corporation.

20-08 Responsive and responsible bidder. A responsive bid conforms to all significant terms and conditions contained in the Owner's invitation for bid. It is the Owner's responsibility to decide if the exceptions taken by a bidder to the solicitation are material or not and the extent of deviation it is willing to accept.

A responsible bidder has the ability to perform successfully under the terms and conditions of a proposed procurement, as defined in 2 CFR § 200.318(h). This includes such matters as Contractor integrity, compliance with public policy, record of past performance, and financial and technical resources.

20-09 Irregular proposals. Proposals shall be considered irregular for the following reasons:

a. If the proposal is on a form other than that furnished by the Owner, or if the Owner's form is altered, or if any part of the proposal form is detached.

b. If there are unauthorized additions, conditional or alternate pay items, or irregularities of any kind that make the proposal incomplete, indefinite, or otherwise ambiguous.

c. If the proposal does not contain a unit price for each pay item listed in the proposal, except in the case of authorized alternate pay items, for which the bidder is not required to furnish a unit price.

d. If the proposal contains unit prices that are obviously unbalanced.

e. If the proposal is not accompanied by the proposal guaranty specified by the Owner.

f. If the applicable Disadvantaged Business Enterprise information is incomplete.

The Owner reserves the right to reject any irregular proposal and the right to waive technicalities if such waiver is in the best interest of the Owner and conforms to local laws and ordinances pertaining to the letting of construction contracts.

20-10 Bid guarantee. Each separate proposal shall be accompanied by a bid bond, certified check, or other specified acceptable collateral, in the amount specified in the proposal form. Such bond, check, or collateral, shall be made payable to the Owner.

20-11 Delivery of proposal. Each proposal submitted shall be placed in a sealed envelope plainly marked with the project number, location of airport, and name and business address of the bidder on the outside. When sent by mail, preferably registered, the sealed proposal, marked as indicated above, should be enclosed in an additional envelope. No proposal will be considered unless received at the place specified in the advertisement or as modified by Addendum before the time specified for opening all bids. Proposals received after the bid opening time shall be returned to the bidder unopened. No faxed or emailed proposals will be accepted. The official time shall be kept locally by the Owner.

20-12 Withdrawal or revision of proposals. A bidder may withdraw or revise (by withdrawal of one proposal and submission of another) a proposal provided that the bidder's request for withdrawal is received by the Owner in writing or by fax or by email before the time specified for opening bids. Revised proposals must be received at the place specified in the advertisement before the time specified for opening all bids.

20-13 Public opening of proposals. Proposals shall be opened, and read, publicly at the time and place specified in the advertisement. Bidders, their authorized agents, and other interested persons are invited to attend. Proposals that have been withdrawn (by written or telegraphic request) or received after the time specified for opening bids shall be returned to the bidder unopened.

20-14 Disqualification of bidders. A bidder shall be considered disqualified for any of the following reasons:

a. Submitting more than one proposal from the same partnership, firm, or corporation under the same or different name.

b. Evidence of collusion among bidders. Bidders participating in such collusion shall be disqualified as bidders for any future work of the Owner until any such participating bidder has been reinstated by the Owner as a qualified bidder.

c. If the bidder is considered to be in "default" for any reason specified in paragraph 20-04, *Issuance of Proposal Forms,* of this section.

20-15 Discrepancies and Omissions. A Bidder who discovers discrepancies or omissions with the project bid documents shall immediately notify the Owner's Engineer of the matter. A bidder that has doubt as to the true meaning of a project requirement may submit to the Owner's Engineer a written request for interpretation no later than 7 calendar days prior to bid opening.

Any interpretation of the project bid documents by the Owner's Engineer will be by written addendum issued by the Owner. The Owner will not consider any instructions, clarifications or interpretations of the bidding documents in any manner other than written addendum.

END OF SECTION 20

Section 30 Award and Execution of Contract

30-01 Consideration of proposals. After the proposals are publicly opened and read, they will be compared on the basis of the summation of the products obtained by multiplying the estimated quantities shown in the proposal by the unit bid prices. If a bidder's proposal contains a discrepancy between unit bid prices written in words and unit bid prices written in numbers, the unit bid price written in words shall govern. Where discrepancies in the summation of the products occur, the Owner will make the necessary corrections and the corrected values will be used in the Owner's consideration of proposals.

Until the award of a contract is made, the Owner reserves the right to reject a bidder's proposal for any of the following reasons:

a. If the proposal is irregular as specified in Section 20, paragraph 20-09, *Irregular Proposals*.

b. If the bidder is disqualified for any of the reasons specified Section 20, paragraph 20-14, *Disqualification of Bidders*.

In addition, until the award of a contract is made, the Owner reserves the right to reject any or all proposals, waive technicalities, if such waiver is in the best interest of the Owner and is in conformance with applicable state and local laws or regulations pertaining to the letting of construction contracts; advertise for new proposals; or proceed with the work otherwise. All such actions shall promote the Owner's best interests.

30-02 Award of contract. The award of a contract, if it is to be awarded, shall be made within 30 calendar days of the date specified for publicly opening proposals, unless otherwise specified herein.

If the Owner elects to proceed with an award of contract, the Owner will make award to the responsible bidder whose bid, conforming with all the material terms and conditions of the bid documents, is the lowest in price.

The Owner reserves the right to award only the Base Bid, to award any Alternate Bid (if Alternates are an option), or to award either the Base Bid or the Alternate Bid plus Add-On Bids (if Add-On bids are an option). Where discrepancies occur that affect the bid total(s) as described in the subsection titled CONSIDERATION OF PROPOSALS, the contract amount awarded will reflect the corrected values.

Where alternate bids and/or add-on bids are included in the proposal, the lowest qualified bidder will be determined by comparison of the combination of Base Bid, or Alternate Bid, plus Add-On bids which are chosen by the Owner.

The Owner, based on their operational needs, has established the following order for evaluation of bids to determine the apparent low bidder:

Base Bid

30-03 Cancellation of award. The Owner reserves the right to cancel the award without liability to the bidder, except return of proposal guaranty, at any time before a contract has been fully executed by all parties and is approved by the Owner in accordance with paragraph 30-07 *Approval of Contract*.

30-04 Return of proposal guaranty. All proposal guaranties, except those of the two lowest bidders, will be returned immediately after the Owner has made a comparison of bids as specified in the paragraph 30-01, *Consideration of Proposals.* Proposal guaranties of the two lowest bidders will be retained by the Owner until such time as an award is made, at which time, the unsuccessful bidder's proposal guaranty

will be returned. The successful bidder's proposal guaranty will be returned as soon as the Owner receives the contract bonds as specified in paragraph 30-05, *Requirements of Contract Bonds*.

30-05 Requirements of contract bonds. At the time of the execution of the contract, the successful bidder shall furnish the Owner a surety bond or bonds that have been fully executed by the bidder and the surety guaranteeing the performance of the work and the payment of all legal debts that may be incurred by reason of the Contractor's performance of the work. The surety and the form of the bond or bonds shall be acceptable to the Owner. Unless otherwise specified in this subsection, the surety bond or bonds shall be in a sum equal to the full amount of the contract.

The successful bidder shall submit in triplicate, a "Performance Bond" guaranteeing the performance of the work equal to one hundred percent (100%) of the amount of the Contract awarded, and a "Labor and Material Payment Bond" guaranteeing the payment of all legal debts that may be incurred by reason of the Contractor's performance of the work equal to one hundred percent (100%) of the amount of the Contract awarded.

30-06 Execution of contract. The successful bidder shall sign (execute) the necessary agreements for entering into the contract and return the signed contract to the Owner, along with the fully executed surety bond or bonds specified in paragraph 30-05, *Requirements of Contract Bonds,* of this section, within 15 calendar days from the date mailed or otherwise delivered to the successful bidder.

The Contractor shall also furnish the required insurance certificates in accordance with the subsection titled RESPONSIBILITY FOR DAMAGE CLAIMS of Sections 70 and 200. The successful bidder shall recognize that the proposal included in the contract for execution may differ from the proposal which was submitted with their bid. The proposal included in the contract for execution will include corrections to discrepancies which were discovered during the Owners consideration of proposals, and will contain only the pages from the successful bidder's proposal which cover the bids which were awarded. As a result, the proposal pages in the contract to be executed may contain pages which are not consecutively numbered due to the intentional omission of those proposal pages which cover bids that were not awarded.

49 CFR Part 26 provides that each contract the owner signs with a contractor (and each subcontract the prime contractor signs with a subcontractor) shall include the following assurance:

> "The contractor, sub-recipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of Department of Transportation (DOT) assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate."

30-07 Approval of contract. Upon receipt of the contract and contract bond or bonds that have been executed by the successful bidder, the Owner shall complete the execution of the contract in accordance with local laws or ordinances, and return the fully executed contract to the Contractor. Delivery of the fully executed contract to the Contractor shall constitute the Owner's approval to be bound by the successful bidder's proposal and the terms of the contract.

30-08 Failure to execute contract. Failure of the successful bidder to execute the contract and furnish an acceptable surety bond or bonds within the period specified in paragraph 30-06, *Execution of Contract,* of this section shall be just cause for cancellation of the award and forfeiture of the proposal guaranty, not as a penalty, but as liquidated damages to the Owner.

END OF SECTION 30

Section 40 Scope of Work

40-01 Intent of contract. The intent of the contract is to provide for construction and completion, in every detail, of the work described. It is further intended that the Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work in accordance with the plans, specifications, and terms of the contract.

40-02 Alteration of work and quantities. The Owner reserves the right to make such changes in quantities and work as may be necessary or desirable to complete, in a satisfactory manner, the original intended work. Unless otherwise specified in the Contract, the Owner's Engineer or RPR shall be and is hereby authorized to make, in writing, such in-scope alterations in the work and variation of quantities as may be necessary to complete the work, provided such action does not represent a significant change in the character of the work.

For purpose of this section, a significant change in character of work means: any change that is outside the current contract scope of work; any change (increase or decrease) in the total contract cost by more than 25%; or any change in the total cost of a major contract item by more than 25%.

Work alterations and quantity variances that do not meet the definition of significant change in character of work shall not invalidate the contract nor release the surety. Contractor agrees to accept payment for such work alterations and quantity variances in accordance with Section 90, paragraph 90-03, *Compensation for Altered Quantities*.

Should the value of altered work or quantity variance meet the criteria for significant change in character of work, such altered work and quantity variance shall be covered by a supplemental agreement. Supplemental agreements shall also require consent of the Contractor's surety and separate performance and payment bonds. If the Owner and the Contractor are unable to agree on a unit adjustment for any contract item that requires a supplemental agreement, the Owner reserves the right to terminate the contract with respect to the item and make other arrangements for its completion.

However, if the Contractor elects to waive the limitations on work that increase or decrease the originally awarded contract or any major contract item by more than 25 percent, the supplemental agreement shall be subject to the same wage determination as was included in the originally awarded contract.

All supplemental agreements shall require consent of the Contractor's surety and separate performance and payment bonds.

40-03 Omitted items. The Owner, the Owner's Engineer or the RPR may provide written notice to the Contractor to omit from the work any contract item that does not meet the definition of major contract item. Major contract items may be omitted by a supplemental agreement. Such omission of contract items shall not invalidate any other contract provision or requirement.

Should a contract item be omitted or otherwise ordered to be non-performed, the Contractor shall be paid for all work performed toward completion of such item prior to the date of the order to omit such item. Payment for work performed shall be in accordance with Section 90, paragraph 90-04, *Payment for Omitted Items*.

40-04 Extra work. Should acceptable completion of the contract require the Contractor to perform an item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, Owner may issue a Change Order to cover the necessary extra work. Change orders for extra work shall contain agreed unit prices for performing the change order work in accordance

with the requirements specified in the order, and shall contain any adjustment to the contract time that, in the RPR's opinion, is necessary for completion of the extra work.

When determined by the RPR to be in the Owner's best interest, the RPR may order the Contractor to proceed with extra work as provided in Section 90, paragraph 90-05, *Payment for Extra Work*. Extra work that is necessary for acceptable completion of the project, but is not within the general scope of the work covered by the original contract shall be covered by a supplemental agreement as defined in Section 10, paragraph 10-59, *Supplemental Agreement*.

If extra work is essential to maintaining the project critical path, RPR may order the Contractor to commence the extra work under a Time and Material contract method. Once sufficient detail is available to establish the level of effort necessary for the extra work, the Owner shall initiate a change order or supplemental agreement to cover the extra work.

Any claim for payment of extra work that is not covered by written agreement (change order or supplemental agreement) shall be rejected by the Owner.

40-05 Maintenance of traffic. It is the explicit intention of the contract that the safety of aircraft, as well as the Contractor's equipment and personnel, is the most important consideration. The Contractor shall maintain traffic in the manner detailed in the Construction Safety and Phasing Plan (CSPP).

a. It is understood and agreed that the Contractor shall provide for the free and unobstructed movement of aircraft in the air operations areas (AOAs) of the airport with respect to their own operations and the operations of all subcontractors as specified in Section 80, paragraph 80-04, *Limitation of Operations*. It is further understood and agreed that the Contractor shall provide for the uninterrupted operation of visual and electronic signals (including power supplies thereto) used in the guidance of aircraft while operating to, from, and upon the airport as specified in Section 70, paragraph 70-15, *Contractor's Responsibility for Utility Service and Facilities of Others*.

b. With respect to their own operations and the operations of all subcontractors, the Contractor shall provide marking, lighting, and other acceptable means of identifying personnel, equipment, vehicles, storage areas, and any work area or condition that may be hazardous to the operation of aircraft, fire-rescue equipment, or maintenance vehicles at the airport in accordance with the construction safety and phasing plan (CSPP) and the safety plan compliance document (SPCD).

c. When the contract requires the maintenance of an existing road, street, or highway during the Contractor's performance of work that is otherwise provided for in the contract, plans, and specifications, the Contractor shall keep the road, street, or highway open to all traffic and shall provide maintenance as may be required to accommodate traffic. The Contractor, at their expense, shall be responsible for the repair to equal or better than preconstruction conditions of any damage caused by the Contractor's equipment and personnel. The Contractor shall furnish, erect, and maintain barricades, warning signs, flag person, and other traffic control devices in reasonable conformity with the Manual on Uniform Traffic Control Devices (MUTCD) (http://mutcd.fhwa.dot.gov/), unless otherwise specified. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary for ingress to and egress from abutting property or intersecting roads, streets or highways. Unless otherwise specified herein, the Contractor will not be required to furnish snow removal for such existing road, street, or highway.

40-06 Removal of existing structures. All existing structures encountered within the established lines, grades, or grading sections shall be removed by the Contractor, unless such existing structures are otherwise specified to be relocated, adjusted up or down, salvaged, abandoned in place, reused in the work or to remain in place. The cost of removing such existing structures shall not be measured or paid for directly, but shall be included in the various contract items.

Should the Contractor encounter an existing structure (above or below ground) in the work for which the disposition is not indicated on the plans, the Resident Project Representative (RPR) shall be notified prior to disturbing such structure. The disposition of existing structures so encountered shall be immediately determined by the RPR in accordance with the provisions of the contract.

Except as provided in Section 40, paragraph 40-07, *Rights in and Use of Materials Found in the Work*, it is intended that all existing materials or structures that may be encountered (within the lines, grades, or grading sections established for completion of the work) shall be used in the work as otherwise provided for in the contract and shall remain the property of the Owner when so used in the work.

40-07 Rights in and use of materials found in the work. Should the Contractor encounter any material such as (but not restricted to) sand, stone, gravel, slag, or concrete slabs within the established lines, grades, or grading sections, the use of which is intended by the terms of the contract to be embankment, the Contractor may at their own option either:

a. Use such material in another contract item, providing such use is approved by the RPR and is in conformance with the contract specifications applicable to such use; or,

b. Remove such material from the site, upon written approval of the RPR; or

c. Use such material for the Contractor's own temporary construction on site; or,

d. Use such material as intended by the terms of the contract.

Should the Contractor wish to exercise option a., b., or c., the Contractor shall request the RPR's approval in advance of such use.

Should the RPR approve the Contractor's request to exercise option a., b., or c., the Contractor shall be paid for the excavation or removal of such material at the applicable contract price. The Contractor shall replace, at their expense, such removed or excavated material with an agreed equal volume of material that is acceptable for use in constructing embankment, backfills, or otherwise to the extent that such replacement material is needed to complete the contract work. The Contractor shall not be charged for use of such material used in the work or removed from the site.

Should the RPR approve the Contractor's exercise of option a., the Contractor shall be paid, at the applicable contract price, for furnishing and installing such material in accordance with requirements of the contract item in which the material is used.

It is understood and agreed that the Contractor shall make no claim for delays by reason of their own exercise of option a., b., or c.

The Contractor shall not excavate, remove, or otherwise disturb any material, structure, or part of a structure which is located outside the lines, grades, or grading sections established for the work, except where such excavation or removal is provided for in the contract, plans, or specifications.

40-08 Final cleanup. Upon completion of the work and before acceptance and final payment will be made, the Contractor shall remove from the site all machinery, equipment, surplus and discarded materials, rubbish, temporary structures, and stumps or portions of trees. The Contractor shall cut all brush and woods within the limits indicated and shall leave the site in a neat and presentable condition. Material cleared from the site and deposited on adjacent property will not be considered as having been disposed of satisfactorily, unless the Contractor has obtained the written permission of the property Owner.

Contractor shall leave the premises broom-clean and everything in perfect order and repair. Upon neglect or refusal of Contractor to keep the premises clean, the RPR shall have the authority to have such work performed, and the cost of the same shall be charged to the Contractor in default and collected from any monies which have or may become due on this Contract. The RPR shall issue no certificates of payment on the Contract until premises are clean, in good order, and all claims properly resolved.

END OF SECTION 40

Section 50 Control of Work

50-01 Authority of the Resident Project Representative (RPR). The RPR has final authority regarding the interpretation of project specification requirements. The RPR shall determine acceptability of the quality of materials furnished, method of performance of work performed, and the manner and rate of performance of the work. The RPR does not have the authority to accept work that does not conform to specification requirements.

50-02 Conformity with plans and specifications. All work and all materials furnished shall be in reasonably close conformity with the lines, grades, grading sections, cross-sections, dimensions, material requirements, and testing requirements that are specified (including specified tolerances) in the contract, plans, or specifications.

If the RPR finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and specifications, but that the portion of the work affected will, in their opinion, result in a finished product having a level of safety, economy, durability, and workmanship acceptable to the Owner, the RPR will advise the Owner of their determination that the affected work be accepted and remain in place. The RPR will document the determination and recommend to the Owner a basis of acceptance that will provide for an adjustment in the contract price for the affected portion of the work. Changes in the contract price must be covered by contract change order or supplemental agreement as applicable.

If the RPR finds the materials furnished, work performed, or the finished product are not in reasonably close conformity with the plans and specifications and have resulted in an unacceptable finished product, the affected work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor in accordance with the RPR's written orders.

The term "reasonably close conformity" shall not be construed as waiving the Contractor's responsibility to complete the work in accordance with the contract, plans, and specifications. The term shall not be construed as waiving the RPR's responsibility to insist on strict compliance with the requirements of the contract, plans, and specifications during the Contractor's execution of the work, when, in the RPR's opinion, such compliance is essential to provide an acceptable finished portion of the work.

The term "reasonably close conformity" is also intended to provide the RPR with the authority, after consultation with the Sponsor and FAA, to use sound engineering judgment in their determinations to accept work that is not in strict conformity, but will provide a finished product equal to or better than that required by the requirements of the contract, plans and specifications.

The RPR will not be responsible for the Contractor's means, methods, techniques, sequences, or procedures of construction or the safety precautions incident thereto.

50-03 Coordination of contract, plans, and specifications. The contract, plans, specifications, and all referenced standards cited are essential parts of the contract requirements. If electronic files are provided and used on the project and there is a conflict between the electronic files and hard copy plans, the hard copy plans shall govern. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions will govern over scaled dimensions; contract technical specifications shall govern over contract general provisions, plans, cited standards for materials or testing, and cited advisory circulars (ACs); contract general provisions shall govern over plans, cited standards for materials or testing, and cited ACs; plans shall govern over cited standards for materials or testing and cited ACs. If

any paragraphs contained in the Special Provisions conflict with General Provisions or Technical Specifications, the Special Provisions shall govern.

From time to time, discrepancies within cited testing standards occur due to the timing of the change, edits, and/or replacement of the standards. If the Contractor discovers any apparent discrepancy within standard test methods, the Contractor shall immediately ask the RPR for an interpretation and decision, and such decision shall be final.

The Contractor shall not take advantage of any apparent error or omission on the plans or specifications. In the event the Contractor discovers any apparent error or discrepancy, Contractor shall immediately notify the Owner or the designated representative in writing requesting their written interpretation and decision.

50-04 List of Special Provisions. See Special Provisions section to the General Provisions.

50-05 Cooperation of Contractor. The Contractor shall be supplied with five hard copies or an electronic PDF of the plans and specifications. The Contractor shall have available on the construction site at all times one hardcopy each of the plans and specifications. Additional hard copies of plans and specifications may be obtained by the Contractor for the cost of reproduction.

The Contractor shall give constant attention to the work to facilitate the progress thereof, and shall cooperate with the RPR and their inspectors and with other Contractors in every way possible. The Contractor shall have a competent superintendent on the work at all times who is fully authorized as their agent on the work. The superintendent shall be capable of reading and thoroughly understanding the plans and specifications and shall receive and fulfill instructions from the RPR or their authorized representative.

50-06 Cooperation between Contractors. The Owner reserves the right to contract for and perform other or additional work on or near the work covered by this contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct the work not to interfere with or hinder the progress of completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with their own contract and shall protect and hold harmless the Owner from any and all damages or claims that may arise because of inconvenience, delays, or loss experienced because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange their work and shall place and dispose of the materials being used to not interfere with the operations of the other Contractors within the limits of the same project. The Contractor shall join their work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

50-07 Construction layout and stakes. The Engineer/RPR shall establish necessary horizontal and vertical control. The establishment of Survey Control and/or reestablishment of survey control shall be by a State Licensed Land Surveyor. Contractor is responsible for preserving integrity of horizontal and vertical controls established by Engineer/RPR. In case of negligence on the part of the Contractor or their employees, resulting in the destruction of any horizontal and vertical control, the resulting costs will be deducted as a liquidated damage against the Contractor.

Prior to the start of construction, the Contractor will check all control points for horizontal and vertical accuracy and certify in writing to the RPR that the Contractor concurs with survey control established for the project. All lines, grades and measurements from control points necessary for the proper execution and control of the work on this project will be provided to the RPR. The Contractor is responsible to establish all layout required for the construction of the project.

Copies of survey notes will be provided to the RPR for each area of construction and for each placement of material as specified to allow the RPR to make periodic checks for conformance with plan grades, alignments and grade tolerances required by the applicable material specifications. Surveys will be provided to the RPR prior to commencing work items that cover or disturb the survey staking. Survey(s) and notes shall be provided in the following format(s): five (5) full size copies of signed and sealed surveys, five (5) copies of the notes as well as pdf copies of both.

Laser, GPS, String line, or other automatic control shall be checked with temporary control as necessary. In the case of error, on the part of the Contractor, their surveyor, employees or subcontractors, resulting in established grades, alignment or grade tolerances that do not concur with those specified or shown on the plans, the Contractor is solely responsible for correction, removal, replacement and all associated costs at no additional cost to the Owner.

No direct payment will be made, unless otherwise specified in contract documents, for this labor, materials, or other expenses. The cost shall be included in the price of the bid for the various items of the Contract.

50-08 Authority and duties of Quality Assurance (QA) inspectors. QA inspectors shall be authorized to inspect all work done and all material furnished. Such QA inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. QA inspectors are not authorized to revoke, alter, or waive any provision of the contract. QA inspectors are not authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

QA Inspectors are authorized to notify the Contractor or their representatives of any failure of the work or materials to conform to the requirements of the contract, plans, or specifications and to reject such nonconforming materials in question until such issues can be referred to the RPR for a decision.

50-09 Inspection of the work. All materials and each part or detail of the work shall be subject to inspection. The RPR shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

If the RPR requests it, the Contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work; but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be at the Contractor’s expense.

Provide advance written notice to the RPR of work the Contractor plans to perform each week and each day. Any work done or materials used without written notice and allowing opportunity for inspection by the RPR may be ordered removed and replaced at the Contractor’s expense.

Should the contract work include relocation, adjustment, or any other modification to existing facilities, not the property of the (contract) Owner, authorized representatives of the Owners of such facilities shall have the right to inspect such work. Such inspection shall in no sense make any facility owner a party to the contract, and shall in no way interfere with the rights of the parties to this contract.

50-10 Removal of unacceptable and unauthorized work. All work that does not conform to the requirements of the contract, plans, and specifications will be considered unacceptable, unless otherwise determined acceptable by the RPR as provided in paragraph 50-02, *Conformity with Plans and Specifications*.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be removed

immediately and replaced in an acceptable manner in accordance with the provisions of Section 70, paragraph 70-14, *Contractor's Responsibility for Work*.

No removal work made under provision of this paragraph shall be done without lines and grades having been established by the RPR. Work done contrary to the instructions of the RPR, work done beyond the lines shown on the plans or as established by the RPR, except as herein specified, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at the Contractor's expense.

Upon failure on the part of the Contractor to comply with any order of the RPR made under the provisions of this subsection, the RPR will have authority to cause unacceptable work to be remedied or removed and replaced; and unauthorized work to be removed and recover the resulting costs as a liquidated damage against the Contractor.

50-11 Load restrictions. The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads beyond the limits of the work. A special permit will not relieve the Contractor of liability for damage that may result from the moving of material or equipment.

The operation of equipment of such weight or so loaded as to cause damage to structures or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. No loads will be permitted on a concrete pavement, base, or structure before the expiration of the curing period. The Contractor, at their own expense, shall be responsible for the repair to equal or better than preconstruction conditions of any damage caused by the Contractor's equipment and personnel.

50-12 Maintenance during construction. The Contractor shall maintain the work during construction and until the work is accepted. Maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces so that the work is maintained in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

All costs of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various contract items, and the Contractor will not be paid an additional amount for such work.

50-13 Failure to maintain the work. Should the Contractor at any time fail to maintain the work as provided in paragraph 50-12, *Maintenance during Construction*, the RPR shall immediately notify the Contractor of such noncompliance. Such notification shall specify a reasonable time within which the Contractor shall be required to remedy such unsatisfactory maintenance condition. The time specified will give due consideration to the exigency that exists.

Should the Contractor fail to respond to the RPR's notification, the Owner may suspend any work necessary for the Owner to correct such unsatisfactory maintenance condition, depending on the exigency that exists. Any maintenance cost incurred by the Owner, shall be recovered as a liquidated damage against the Contractor.

50-14 Partial acceptance. If at any time during the execution of the project the Contractor substantially completes a usable unit or portion of the work, the occupancy of which will benefit the Owner, the Contractor may request the RPR to make final inspection of that unit. If the RPR finds upon inspection that the unit has been satisfactorily completed in compliance with the contract, the RPR may accept it as being complete, and the Contractor may be relieved of further responsibility for that unit. Such partial acceptance and beneficial occupancy by the Owner shall not void or alter any provision of the contract.

50-15 Final acceptance. Upon due notice from the Contractor of presumptive completion of the entire project, the RPR and Owner will make an inspection. If all construction provided for and contemplated by the contract is found to be complete in accordance with the contract, plans, and specifications, such inspection shall constitute the final inspection. The RPR shall notify the Contractor in writing of final acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the RPR will notify the Contractor and the Contractor shall correct the unsatisfactory work. Upon correction of the work, another inspection will be made which shall constitute the final inspection, provided the work has been satisfactorily completed. In such event, the RPR will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of final inspection.

50-16 Claims for adjustment and disputes. If for any reason the Contractor deems that additional compensation is due for work or materials not clearly provided for in the contract, plans, or specifications or previously authorized as extra work, the Contractor shall notify the RPR in writing of their intention to claim such additional compensation before the Contractor begins the work on which the Contractor bases the claim. If such notification is not given or the RPR is not afforded proper opportunity by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive any claim for such additional compensation. Such notice by the Contractor and the fact that the RPR has kept account of the cost of the work shall not in any way be construed as proving or substantiating the validity of the claim. When the work on which the claim for additional compensation is based has been completed, the Contractor shall, within 10 calendar days, submit a written claim to the RPR who will present it to the Owner for consideration in accordance with local laws or ordinances.

Nothing in this subsection shall be construed as a waiver of the Contractor’s right to dispute final payment based on differences in measurements or computations.

END OF SECTION 50

Section 60 Control of Materials

60-01 Source of supply and quality requirements. The materials used in the work shall conform to the requirements of the contract, plans, and specifications. Unless otherwise specified, such materials that are manufactured or processed shall be new (as compared to used or reprocessed).

In order to expedite the inspection and testing of materials, the Contractor shall furnish documentation to the RPR as to the origin, composition, and manufacture of all materials to be used in the work. Documentation shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials.

At the RPR's option, materials may be approved at the source of supply before delivery. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources.

The Contractor shall furnish airport lighting equipment that meets the requirements of the specifications; and is listed in AC 150/5345-53, *Airport Lighting Equipment Certification Program* and *Addendum*, that is in effect on the date of advertisement.

All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification.

60-02 Samples, tests, and cited specifications. All materials used in the work shall be inspected, tested, and approved by the RPR before incorporation in the work unless otherwise designated. Any work in which untested materials are used without approval or written permission of the RPR shall be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be paid for and, if directed by the RPR, shall be removed at the Contractor's expense.

Unless otherwise designated, quality assurance tests will be made by and at the expense of the Owner in accordance with the cited standard methods of ASTM, American Association of State Highway and Transportation Officials (AASHTO), federal specifications, Commercial Item Descriptions, and all other cited methods, which are current on the date of advertisement for bids.

The testing organizations performing on-site quality assurance field tests shall have copies of all referenced standards on the construction site for use by all technicians and other personnel. Unless otherwise designated, samples for quality assurance will be taken by a qualified representative of the RPR. All materials being used are subject to inspection, test, or rejection at any time prior to or during incorporation into the work. Copies of all tests will be furnished to the Contractor's representative at their request after review and approval of the RPR.

A copy of all Contractor QC test data shall be provided to the RPR daily, along with printed reports, in an approved format, on a weekly basis. After completion of the project, and prior to final payment, the Contractor shall submit a final report to the RPR showing all test data reports, plus an analysis of all results showing ranges, averages, and corrective action taken on all failing tests.

The Contractor shall employ a Quality Control (QC) testing organization to perform all Contractor required QC tests in accordance with Item C-100 Contractor Quality Control Program (CQCP).

60-03 Certification of compliance/analysis (COC/COA). The RPR may permit the use, prior to sampling and testing, of certain materials or assemblies when accompanied by manufacturer's COC stating that such materials or assemblies fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer. Each lot of such materials or assemblies delivered to the work must be accompanied by a certificate of compliance in which the lot is clearly identified. The COA is the manufacturer's COC and includes all applicable test results.

Manufacturer's certificates of compliance shall not relieve the Contractor of their responsibility to provide materials in accordance with these specifications and acceptable to the RPR. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the RPR, and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

Materials or assemblies used on the basis of certificates of compliance may be sampled and tested at any time and if found not to be in conformity with contract requirements will be subject to rejection whether in place or not.

The form and distribution of certificates of compliance shall be as approved by the RPR.

When a material or assembly is specified by "brand name or equal" and the Contractor elects to furnish the specified "or equal," the Contractor shall be required to furnish the manufacturer's certificate of compliance for each lot of such material or assembly delivered to the work. Such certificate of compliance shall clearly identify each lot delivered and shall certify as to:

a. Conformance to the specified performance, testing, quality or dimensional requirements; and,

b. Suitability of the material or assembly for the use intended in the contract work.

The RPR shall be the sole judge as to whether the proposed "or equal" is suitable for use in the work.

The RPR reserves the right to refuse permission for use of materials or assemblies on the basis of certificates of compliance.

60-04 Plant inspection. The RPR or their authorized representative may inspect, at its source, any specified material or assembly to be used in the work. Manufacturing plants may be inspected from time to time for the purpose of determining compliance with specified manufacturing methods or materials to be used in the work and to obtain samples required for acceptance of the material or assembly.

Should the RPR conduct plant inspections, the following conditions shall exist:

a. The RPR shall have the cooperation and assistance of the Contractor and the producer with whom the Contractor has contracted for materials.

b. The RPR shall have full entry at all reasonable times to such parts of the plant that concern the manufacture or production of the materials being furnished.

c. If required by the RPR, the Contractor shall arrange for adequate office or working space that may be reasonably needed for conducting plant inspections. Place office or working space in a convenient location with respect to the plant.

It is understood and agreed that the Owner shall have the right to retest any material that has been tested and approved at the source of supply after it has been delivered to the site. The RPR shall have the right to reject only material which, when retested, does not meet the requirements of the contract, plans, or specifications.

60-05 Engineer/ Resident Project Representative (RPR) field office. The Engineer/RPR field office, if required, shall be as indicated in C-105, Mobilization.

60-06 Storage of materials. Materials shall be stored to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located to facilitate their prompt inspection. The Contractor shall coordinate the storage of all materials with the RPR. Materials to be stored on airport property shall not create an obstruction to air navigation nor shall they interfere with the free and unobstructed movement of aircraft. Unless otherwise shown on the plans and/or CSPP, the storage of materials and the location of the Contractor's plant and parked equipment or vehicles shall be as directed by the RPR. Private property shall not be used for storage purposes without written permission of the Owner or lessee of such property. The Contractor shall make all arrangements and bear all expenses for the storage of materials on private property. Upon request, the Contractor shall furnish the RPR a copy of the property Owner's permission.

All storage sites on private or airport property shall be restored to their original condition by the Contractor at their expense, except as otherwise agreed to (in writing) by the Owner or lessee of the property.

60-07 Unacceptable materials. Any material or assembly that does not conform to the requirements of the contract, plans, or specifications shall be considered unacceptable and shall be rejected. The Contractor shall remove any rejected material or assembly from the site of the work, unless otherwise instructed by the RPR.

Rejected material or assembly, the defects of which have been corrected by the Contractor, shall not be returned to the site of the work until such time as the RPR has approved its use in the work.

60-08 Owner furnished materials. The Contractor shall furnish all materials required to complete the work, except those specified, if any, to be furnished by the Owner. Owner-furnished materials shall be made available to the Contractor at the location specified.

All costs of handling, transportation from the specified location to the site of work, storage, and installing Owner-furnished materials shall be included in the unit price bid for the contract item in which such Owner-furnished material is used.

After any Owner-furnished material has been delivered to the location specified, the Contractor shall be responsible for any demurrage, damage, loss, or other deficiencies that may occur during the Contractor's handling, storage, or use of such Owner-furnished material. The Owner will deduct from any monies due or to become due the Contractor any cost incurred by the Owner in making good such loss due to the Contractor's handling, storage, or use of Owner-furnished materials.

END OF SECTION 60

Section 70 Legal Regulations and Responsibility to Public

70-01 Laws to be observed. The Contractor shall keep fully informed of all federal and state laws, all local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. The Contractor shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the Owner, the Engineer, the RPR and all their officers, agents, or servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor or the Contractor's employees.

70-02 Permits, licenses, and taxes. The Contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful execution of the work.

70-03 Patented devices, materials, and processes. If the Contractor is required or desires to use any design, device, material, or process covered by letters of patent or copyright, the Contractor shall provide for such use by suitable legal agreement with the Patentee or Owner. The Contractor and the surety shall indemnify and hold harmless the Owner, the Engineer, the RPR, any third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the Owner for any costs, expenses, and damages which it may be obliged to pay by reason of an infringement, at any time during the execution or after the completion of the work.

70-04 Restoration of surfaces disturbed by others. The Owner reserves the right to authorize the construction, reconstruction, or maintenance of any public or private utility service, FAA or National Oceanic and Atmospheric Administration (NOAA) facility, or a utility service of another government agency at any time during the progress of the work. To the extent that such construction, reconstruction, or maintenance has been coordinated with the Owner, such authorized work (by others) must be shown on the plans and is indicated as follows:

Utility	Location (Sheet No.)	Person to Contact	Phone No.

"Not Applicable"

Except as listed above, the Contractor shall not permit any individual, firm, or corporation to excavate or otherwise disturb such utility services or facilities located within the limits of the work without the written permission of the RPR.

Should the Owner of public or private utility service, FAA, or NOAA facility, or a utility service of another government agency be authorized to construct, reconstruct, or maintain such utility service or facility during the progress of the work, the Contractor shall cooperate with such Owners by arranging and performing the work in this contract to facilitate such construction, reconstruction or maintenance by others whether or not such work by others is listed above. When ordered as extra work by the RPR, the Contractor shall make all necessary repairs to the work which are due to such authorized work by others,

unless otherwise provided for in the contract, plans, or specifications. It is understood and agreed that the Contractor shall not be entitled to make any claim for damages due to such authorized work by others or for any delay to the work resulting from such authorized work.

70-05 Federal Participation. The United States Government has agreed to reimburse the Owner for some portion of the contract costs. The contract work is subject to the inspection and approval of duly authorized representatives of the FAA Administrator. No requirement of this contract shall be construed as making the United States a party to the contract nor will any such requirement interfere, in any way, with the rights of either party to the contract.

70-06 Sanitary, health, and safety provisions. The Contractor's worksite and facilities shall comply with applicable federal, state, and local requirements for health, safety and sanitary provisions.

70-07 Public convenience and safety. The Contractor shall control their operations and those of their subcontractors and all suppliers, to assure the least inconvenience to the traveling public. Under all circumstances, safety shall be the most important consideration.

The Contractor shall maintain the free and unobstructed movement of aircraft and vehicular traffic with respect to their own operations and those of their own subcontractors and all suppliers in accordance with Section 40, paragraph 40-05, *Maintenance of Traffic*, and shall limit such operations for the convenience and safety of the traveling public as specified in Section 80, paragraph 80-04, *Limitation of Operations*.

The Contractor shall remove or control debris and rubbish resulting from its work operations at frequent intervals, and upon the order of the RPR. If the RPR determines the existence of Contractor debris in the work site represents a hazard to airport operations and the Contractor is unable to respond in a prompt and reasonable manner, the RPR reserves the right to assign the task of debris removal to a third party and recover the resulting costs as a liquidated damage against the Contractor.

70-08 Construction Safety and Phasing Plan (CSPP). The Contractor shall complete the work in accordance with the approved Construction Safety and Phasing Plan (CSPP) developed in accordance with AC 150/5370-2, Operational Safety on Airports During Construction. The CSPP is described in the Construction Safety and Phasing Plan, Appendix A to Section 70 Item 1000410.

During the work of this Contract, the Owner will make such arrangements to coordinate aircraft movements and Airport operations as necessary to conform to the construction procedures outlined in the Construction Safety and Phasing Plan, and as shown on the Contract Drawings. The Contractor shall give adequate notice to the RPR, so as to afford time to coordinate construction with the Owner.

70-09 Use of explosives. The use of explosives is not permitted on this project.

70-10 Protection and restoration of property and landscape. The Contractor shall be responsible for the preservation of all public and private property, and shall protect carefully from disturbance or damage all land monuments and property markers until the Engineer/RPR has witnessed or otherwise referenced their location and shall not move them until directed.

The Contractor shall be responsible for all damage or injury to property of any character, during the execution of the work, resulting from any act, omission, neglect, or misconduct in manner or method of executing the work, or at any time due to defective work or materials, and said responsibility shall not be released until the project has been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the non-execution thereof by the Contractor, the Contractor shall restore, at their expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, or otherwise restoring as may be directed, or the Contractor shall make good such damage or injury in an acceptable manner.

The Contractor shall indemnify the Owner for any and all costs for the repair or replacement of the Owner's property including, but not limited to, buildings and roads, which arise from or in any manner grow out of any act or neglect on or about the Project site by the Contractor and anyone for whom the Contractor is legally liable.

70-11 Responsibility for damage claims. The Contractor shall indemnify, defend and hold harmless the Engineer/RPR and the Owner and their respective representatives, directors, officers, agents, and employees from all suits, actions, damages, costs, expenses or claims, of any character, (including attorney's fees), and liability (including statutory liability) brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct or arising out of or related to any negligence of the Contractor or anyone for whom the Contractor is legally liable in performing or safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any and all environmental impairment; or because of any act or omission, neglect, or misconduct of said Contractor or anyone for whom the Contractor is legally liable of said Contractor; or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the "Workmen's Compensation Act," or any other law, ordinance, order, or decree. Money due the Contractor under and by virtue of their own contract considered necessary by the Owner for such purpose may be retained for the use of the Owner or, in case no money is due, their own surety may be held until such suits, actions, or claims for injuries or damages shall have been settled and suitable evidence to that effect furnished to the Owner, except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that he or she is adequately protected by public liability and property damage insurance.

As a material part of the consideration to be rendered by the Owner, the Contractor hereby waives all claims against the Owner for damages to the goods, wares, and merchandise in, upon, or about the Project, and the Contractor will hold the Owner exempt and harmless from any damage and injury to any such person or to the goods, wares, or merchandise of any such person, arising from the use of the Project site by the Contractor or from failure of the Contractor to keep the Project site in good condition and repair as provided in this Section.

70-12 Third party beneficiary clause. It is specifically agreed between the parties executing the contract that it is not intended by any of the provisions of any part of the contract to create for the public or any member thereof, a third-party beneficiary or to authorize anyone not a party to the contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the contract.

70-13 Opening sections of the work to traffic. If it is necessary for the Contractor to complete portions of the contract work for the beneficial occupancy of the Owner prior to completion of the entire contract, such "phasing" of the work must be specified below and indicated on the approved Construction Safety

and Phasing Plan (CSPP) and the project plans. When so specified, the Contractor shall complete such portions of the work on or before the date specified or as otherwise specified.

Opening sections of work to traffic shall be as described in the CSPP.

Upon completion of any portion of work listed above, such portion shall be accepted by the Owner in accordance with Section 50, paragraph 50-14, *Partial Acceptance*.

No portion of the work may be opened by the Contractor until directed by the Owner in writing. Should it become necessary to open a portion of the work to traffic on a temporary or intermittent basis, such openings shall be made when, in the opinion of the RPR, such portion of the work is in an acceptable condition to support the intended traffic. Temporary or intermittent openings are considered to be inherent in the work and shall not constitute either acceptance of the portion of the work so opened or a waiver of any provision of the contract. Any damage to the portion of the work so opened that is not attributable to traffic which is permitted by the Owner shall be repaired by the Contractor at their expense.

The Contractor shall make their own estimate of the inherent difficulties involved in completing the work under the conditions herein described and shall not claim any added compensation by reason of delay or increased cost due to opening a portion of the contract work.

The Contractor must conform to safety standards contained AC 150/5370-2 and the approved CSPP.

Contractor shall refer to the plans, specifications, and the approved CSPP to identify barricade requirements, temporary and/or permanent markings, airfield lighting, guidance signs and other safety requirements prior to opening up sections of work to traffic.

70-14 Contractor's responsibility for work. Until the RPR's final written acceptance of the entire completed work, excepting only those portions of the work accepted in accordance with Section 50, paragraph 50-14, *Partial Acceptance*, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part due to the action of the elements or from any other cause, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God such as earthquake, tidal wave, tornado, hurricane or other cataclysmic phenomenon of nature, or acts of the public enemy or of government authorities.

If the work is suspended for any cause whatever, the Contractor shall be responsible for the work and shall take such precautions necessary to prevent damage to the work. The Contractor shall provide for normal drainage and shall erect necessary temporary structures, signs, or other facilities at their own expense. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established planting, seeding, and sodding furnished under the contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

70-15 Contractor's responsibility for utility service and facilities of others. As provided in paragraph 70-04, *Restoration of Surfaces Disturbed by Others*, the Contractor shall cooperate with the owner of any public or private utility service, FAA or NOAA, or a utility service of another government agency that may be authorized by the Owner to construct, reconstruct or maintain such utility services or facilities

during the progress of the work. In addition, the Contractor shall control their operations to prevent the unscheduled interruption of such utility services and facilities.

To the extent that such public or private utility services, FAA, or NOAA facilities, or utility services of another governmental agency are known to exist within the limits of the contract work, the approximate locations have been indicated on the plans and/or in the contract documents.

Utility Service or Facility	Person to Contract	Contact Information
FAA Airway Facilities	Peter Wilke	peter.wilke@faa.gov
NOAA Federal	Joseph Murphy	joseph.murphy@noaa.gov
NOAA Federal	Robert Wilson	robert.n.wilson@noaa.gov

It is understood and agreed that the Owner does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities, or structures that may be shown on the plans or encountered in the work. Any inaccuracy or omission in such information shall not relieve the Contractor of the responsibility to protect such existing features from damage or unscheduled interruption of service.

It is further understood and agreed that the Contractor shall, upon execution of the contract, notify the Owners of all utility services or other facilities of their plan of operations. Such notification shall be in writing addressed to "The Person to Contact" as provided in this paragraph and paragraph 70-04, *Restoration of Surfaces Disturbed By Others*. A copy of each notification shall be given to the RPR.

In addition to the general written notification provided, it shall be the responsibility of the Contractor to keep such individual Owners advised of changes in their plan of operations that would affect such Owners.

Prior to beginning the work in the general vicinity of an existing utility service or facility, the Contractor shall again notify each such Owner of their plan of operation. If, in the Contractor's opinion, the Owner's assistance is needed to locate the utility service or facility or the presence of a representative of the Owner is desirable to observe the work, such advice should be included in the notification. Such notification shall be given by the most expeditious means to reach the utility owner's "Person to Contact" no later than two normal business days prior to the Contractor's commencement of operations in such general vicinity. The Contractor shall furnish a written summary of the notification to the RPR.

The Contractor's failure to give the two days' notice shall be cause for the Owner to suspend the Contractor's operations in the general vicinity of a utility service or facility.

Where the outside limits of an underground utility service have been located and staked on the ground, the Contractor shall be required to use hand excavation methods within 3 feet (1 m) of such outside limits at such points as may be required to ensure protection from damage due to the Contractor's operations.

Should the Contractor damage or interrupt the operation of a utility service or facility by accident or otherwise, the Contractor shall immediately notify the proper authority and the RPR and shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility owner and the RPR continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility owner.

The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to their operations whether due to negligence or accident. The Owner reserves the right to deduct such costs from any monies due or which may become due the Contractor, or their own surety.

70-16 Furnishing rights-of-way. The Owner will be responsible for furnishing all rights-of-way upon which the work is to be constructed in advance of the Contractor's operations.

70-17 Personal liability of public officials. In carrying out any of the contract provisions or in exercising any power or authority granted by this contract, there shall be no liability upon the Engineer, RPR, their authorized representatives, or any officials of the Owner either personally or as an official of the Owner. It is understood that in such matters they act solely as agents and representatives of the Owner.

70-18 No waiver of legal rights. Upon completion of the work, the Owner will expeditiously make final inspection and notify the Contractor of final acceptance. Such final acceptance, however, shall not preclude or stop the Owner from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Owner be precluded or stopped from recovering from the Contractor or their surety, or both, such overpayment as may be sustained, or by failure on the part of the Contractor to fulfill their obligations under the contract. A waiver on the part of the Owner of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract, shall be liable to the Owner for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Owner's rights under any warranty or guaranty.

70-19 Environmental protection. The Contractor shall comply with all federal, state, and local laws and regulations controlling pollution of the environment. The Contractor shall take necessary precautions to prevent pollution of streams, lakes, ponds, and reservoirs with fuels, oils, asphalts, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

The Contractor shall perform all testing, removal of contaminated material, transportation, treatment, remediation, and disposal of contaminated materials which are the result of a spill or release caused by the Contractor, and he shall provide and properly place materials to restore the property to its original condition, all to the Owner's satisfaction and at the Contractor's expense. Refer to the subsection 70-10 titled PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE of this section.

A. Air Pollution

1. No burning of combustible waste shall be permitted.
2. Alternatives to Burning Land Cleared Material.
    a. All spoil material from clearing and grubbing operations shall be disposed of in accordance with the Technical Specifications, unless otherwise directed.
    b. Wood may be salvaged for firewood or commercial use or it may be chipped and disposed of for use as mulch.
    c. Logs, brush, etc. may be removed to an authorized disposal area or disposed of to the general public without charge.
3. Dust Control.
    a. Common construction operations which may cause excessive dust include:
        1) Quarry, drilling and rock crushing.

2) Clearing, grubbing and stripping.

3) Excavation and placement of embankment.

4) Cement and aggregate handling.

5) Cement or lime stabilization.

6) Blasting.

7) Use of haul roads.

8) Sandblasting or grinding.

b. Other construction operations which may cause air pollution are:

1) Volatiles escaping from asphalt and cut back materials.

2) Use of herbicides or fertilizers.

3) Smoke from asphalt plants or heater/planers.

c. Control of Dust and Other Air Pollutants shall be the responsibility of the Contractor and may include the following control methods:

1) Drilling apparatus equipped with water or chemical dust controlling systems.

2) Exposing the minimum area of land.

3) Applying temporary mulch with or without seeding.

4) Use of water sprinkling trucks.

5) Use of covered haul trucks.

6) Use of stabilizing agents in solution.

7) Use of dust palliative and penetration asphalt on temporary roads.

8) Use of wood chips in traffic or work areas.

9) Use of vacuum equipped sandblasting systems.

10) Use of plastic sheet coverings.

11) Restricting the application rate of herbicides to recommended dosage. Materials should be covered and protected from the elements. Application, equipment and empty containers shall not be rinsed and discharged to a stream, etc. or allowed to enter the groundwater.

12) Use dust control measures at bituminous mixing plants, and quarry operations.

13) Delay operations until climate or wind conditions dissipate or inhibit the potential pollutants in a manner satisfactory to the RPR.

B. Water Pollution

1. The Contractor shall use suitable precautions to minimize water pollution during the progress of the work. Erosion control devices or methods may consist of berms, dikes, dams, drains, sediment basins, fiber mats, woven plastic filter cloths, gravel, mulches, quick growing grasses, sod, bituminous spray or other control devices.

2. The amount of surface area of erodible earth at any one time shall not exceed the area allowed by permit.

3. Pollutants such as fuels, lubricants, bitumens, raw sewage and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or man-made channels leading thereto. Wash water or waste from concrete mixing and curing operations should not be allowed to enter streams, etc.

In the event of conflict between these requirements and pollution control laws, rules or regulations or other Federal, State or local agencies, the more restrictive laws, rules, or regulations shall apply.

70-20 Archaeological and historical findings. Unless otherwise specified in this subsection, the Contractor is advised that the site of the work is not within any property, district, or site, and does not contain any building, structure, or object listed in the current National Register of Historic Places published by the United States Department of Interior.

Should the Contractor encounter, during their operations, any building, part of a building, structure, or object that is incongruous with its surroundings, the Contractor shall immediately cease operations in that location and notify the RPR. The RPR will immediately investigate the Contractor's finding and the Owner will direct the Contractor to either resume operations or to suspend operations as directed.

Should the Owner order suspension of the Contractor's operations in order to protect an archaeological or historical finding, or order the Contractor to perform extra work, such shall be covered by an appropriate contract change order or supplemental agreement as provided in Section 40, paragraph 40-04, *Extra Work*, and Section 90, paragraph 90-05, *Payment for Extra Work*. If appropriate, the contract change order or supplemental agreement shall include an extension of contract time in accordance with Section 80, paragraph 80-07, *Determination and Extension of Contract Time*.

70-21 Insurance Requirements.

The Contractor, at his own expense, shall procure and maintain, until final acceptance by the Owner of the work covered by the Contract, comprehensive liability insurance for damages imposed by law of the kinds and in the amounts hereinafter provided, written by a financially solvent insurance company authorized to do such business and write such coverage in the place where the Project is located, covering all operations under the Contract, whether performed by the Contractor or by its Subcontractor(s). Before commencing the work, the Contractor shall furnish to the Owner three (3) certificates of insurance, in satisfactory form to the Owner, showing that the Contractor has complied with the requirements of this Section. The policies and certificates shall provide that the policies shall not be changed or canceled until thirty (30) days after written notice thereof has been given to each of the Additional Insureds listed below. Property damage insurance shall include coverage for explosion, collapse, and underground operations (X C U hazards).

A. The kinds and amounts of insurance are as follows:

   1. General Liability insurance policies shall be Commercial General Liability Insurance (coverage for bodily injury, personal injury, property damage (broad form), premises/operations, blanket contractual, and products/completed operations. Coverage shall be endorsed to include the Gerald R. Ford International Airport Authority, Authority Board, and Kent County as an additional insured for work performed by the Contractor in accordance with the Agreement.

      Minimum Limits:

      - $5,000,000 per occurrence or $10,000,000

2. Automobile Liability policies shall cover Michigan No-Fault coverage “All Owned”, “Scheduled”, “Hired” and “Non-Owned” autos.

   The minimum Combined Single Limit shall be:

   - No-fault coverages – statutory
   - $5,000,000 per occurrence combined single limit for bodily injury and property damage

3. Workers’ Compensation and Employer’s Liability Policy shall have statutory coverage or proof acceptable to the Authority of approval as a self-insurer by the State of Michigan. Policy or policies covering the obligations of the Contractor in accordance with the provisions of any applicable Worker's Compensation or Disability Benefits Law.

   Minimum Limits:

   - Workers’ Compensation – statutory
   - Employer’s Liability - $100,000 each accident/$100,000 disease – each employee
   - $500,000 disease – policy limit

4. If applicable, the Contractor and its Subcontractor(s) engaged in work involving “hazardous substances,” as defined in Section 3 of PL 1993, c. 139 (C.13:1K-8), or “hazardous waste,” as defined in Section 1 of PL 1976, c. 99 (C.13:1E-38), shall procure and maintain pollution liability insurance, also known as “environmental impairment liability insurance.”

5. Insurance coverage shall cover all claims against the Authority, their officials and employees, arising out of the work performed by the Contractor or any subcontractors under the Agreement. Should any work be subcontracted, it shall be the responsibility of the Contractor to maintain Independent Contractor’s Protective Liability Insurance with limits equal to those specified above for Commercial General Liability Insurance. In addition, the Contractor shall provide proof of Workers’ Compensation Insurance for all subcontractors in compliance with the required statutory limits of the State of Michigan.

6. The insurance policies shall be with companies licensed to do business in the State of Michigan and in a form satisfactory to the Authority. Certificates of insurance with a thirty-(30) day cancellation clause shall be filed with and approved by the Authority at least five (5) days in advance of commencing work under the Agreement. Cancellation, material restriction, nonrenewal or lapse of any of the required policies shall be grounds for immediate termination of the Agreement by the Authority.

7. The Authority reserves the right to request a complete certified copy of the policies for the above coverage’s.

8. Any reduction or exhaustion in the limits of required insurance coverage shall not be deemed to limit the indemnification afforded in accordance with the Agreement or any amendments thereto.

9. Following are the minimum insurance limits for airport construction projects.

10. For the land side, a minimum limit for low hazard projects is $2,000,000. For higher hazard projects, $5,000,000 General Liability limit is recommended.

11. For the airside, a minimum General Liability limit of $5,000,000 is recommended for small low hazard projects with a size of less than $5,000,000. However, if the project involves the runways or medium to large projects for longer duration than 180 days and project size is greater than $5,000,000, then minimum General Liability limit is $10,000,000.

B. Contractor's insurance shall be primary over all other collectible insurance.

C. Anti-subrogation applies to General Liability and to Automobile Liability insurance coverages.

D. The Certificate Holder shall be the Contractor.

E. The following shall be named as Additional Insureds: Gerald R. Ford International Airport, RPR; the Federal Aviation Administration; and the County of Kent.

F. The General Liability policies shall provide coverage for liability for damages imposed by law upon the Contractor and its Subcontractor(s) with respect to all work performed by any of them under the Contract. The insurance company providing General Liability insurance coverage acknowledges that the Contractor has agreed in this Contract to defend, hold harmless, and indemnify the Owner, the Engineer, the RPR, and their respective directors, officers, representatives and employees as set forth in this Section.

G. The Contractor's policies shall provide coverage for contractual liability imposed by contract, including this Contract, and completed operations liability for damages imposed by law arising between the date of the certification of completion of the work and the date of the expiration of the Contractor's guarantee.

H. Contractor's policy shall provide coverage for liability arising out of the acts or omissions of its Subcontractors.

I. Each Subcontractor employed on the Project site by the Contractor shall provide comprehensive liability insurance in accordance with the above-described requirements of the Contractor. Such insurance requirements shall be submitted to the RPR as part of the Subcontractor approval process.

END OF SECTION 70

ATTACHMENT "A"

TO

SECTION 70 08

SAFETY AND SECURITY

CONSTRUCTION SAFETY AND PHASING PLAN (CSPP)

FOR THE CONSTRUCTION OF

SRE BUILDING EXPANSION

AT

GERALD R. FORD INTERNATIONAL AIRPORT
GRAND RAPIDS, MI

SEPTEMBER 18, 2023

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CONSTRUCTION SAFETY AND PHASING PLAN (CSPP)

1.0 PURPOSE.

Aviation safety is the primary consideration at airports, especially during construction. The Airport Owner's Construction Safety and Phasing Plan (CSPP) and the Contractor's Safety Plan Compliance Document (SPCD) are the primary tools to ensure safety compliance when coordinating construction activities with airport operations. These documents identify all aspects of the construction project that pose a potential safety hazard to airport operations and outline respective mitigation procedures for each hazard.

The CSPP sets forth benchmarks and requirements for the project to help ensure the highest levels of safety, security and efficiency at the airport at the time of construction. Requirements for this CSPP were developed from FAA Advisory Circular (AC) 150/5370-2 Operational Safety on Airports During Construction, latest edition.

The CSPP is a standalone document, written to correspond with the safety and security requirements set forth in the AC, the airport safety and security requirements, and local codes and requirements. The CSPP is to be used by all personnel involved in the project. The CSPP covers the actions of not only the construction personnel and equipment, but also the action of inspection personnel and airport staff.

This document has been developed in order to minimize interruptions to airport operations, reduce construction costs, and maximize the performance and safety of construction activity. Strict adherence to the provisions of the CSPP by all personnel assigned to or visiting the construction site is mandatory.

The Contractor shall submit a Safety Plan Compliance Document (SPCD) to the Airport Owner describing how the Contractor will comply with the requirements set forth in this CSPP. The SPCD must be submitted to the Airport Owner prior to issuance of Notice to Proceed.

In the event the Contractor's activities are found in non-compliance with the provisions of the CSPP or the SPCD, the Airport Owner's Representative will direct the Contractor, in writing, to immediately cease those operations in violation. In addition, a safety meeting will be conducted for the purpose of reviewing those provisions in the CSPP/SPCD which were violated. The Contractor will not be allowed to resume any construction operations until conclusion of the safety meeting and all corrective actions have been implemented.

2.0 SCOPE OF PROJECT AND CSPP.

The proposed project generally includes the expansion of the Airport Field Maintenance Snow Removal Equipment (SRE) Building and removal of an existing underground storage tanks and fueling facility of a vehicle and equipment fueling facility.

Safety, maintaining aircraft operations, and construction costs are all interrelated. Since safety must not be compromised, the Airport Owner must strike a balance between maintaining aircraft operations and construction costs. This balance will vary widely depending on the operational needs and resources of the airport and will require early coordination with airport users and the FAA. As the project design progresses, the necessary construction locations, activities and associated costs will be identified. As they are identified, their impact to airport operations must be assessed. Adjustments are made to the proposed construction activities, often by phasing the project and/or to airport operations in order to maintain operational safety. This planning effort will ultimately result in a project CSPP. The development of the CSPP takes place through the following five steps:

- **a.** Identify Affected Areas
- **b.** Describe Current Operations
- **c.** Allow for Temporary Changes to Operations

d. Take Required Measures to Revise Operations
e. Manage Safety Risk

3.0 PLAN REQUIREMENTS.

3.1 COORDINATION. The following items shall be coordinated as required:

a. Pre-construction Meeting. A preconstruction meeting will be conducted to discuss operational safety, testing, quality control, quality acceptance, security, safety, labor requirements, environmental factors, and other issues. All parties affected by the construction will be asked to attend including, but not limited to, the Airport Owner, tenants, contractor, subcontractors and Resident Project Representative (RPR).

At the preconstruction meeting, the Contractor shall submit a plan of operation and schedule of work to the RPR for approval. The Contractor's plan of operation shall indicate, in detail, the amount of construction planned and the number of shifts and/or overtime operations proposed for the project. The schedule of work shall clearly indicate the sequence of work to be performed. The Contractor shall conform, at all times, to the requirements of these provisions and with current safety practices, rules, regulations and security requirements of Airport Owner. The preconstruction meeting will be held prior to issuance of a Notice to Proceed.

b. Contractor Progress Meetings. A minimum of one progress meeting to discuss scheduling and coordination shall be held each week unless otherwise directed by the Airport Owner, throughout the duration of the Contract, between the Airport Owner, Contractor, RPR and any other interested parties at a time and place to be designated by the RPR. These meetings shall include a detailed discussion of construction phasing and safety with regard to the Contractor's compliance with the requirements stipulated in the Contract Documents.

In attendance at these meetings shall be a Contractor's representative with the authority to make decisions concerning the scheduling and coordination of work. Progress meetings shall be facilitated by the RPR. Operational safety shall be a standing agenda item during progress meetings throughout the construction project.

c. Scope or Schedule Changes. Changes in the Scope of Work or Project Schedule shall be governed by the Contract Documents. Any proposed change that results in a deviation from the established CSPP as expressed by the Contract Documents must be submitted to the FAA and Airport Owner for review and approval. FAA review and approval can be expected to take sixty business days.

d. FAA ATO Coordination. Early coordination with Federal Aviation Administration (FAA) Air Traffic Organization (ATO) required for scheduling Technical Operations shutdowns prior to construction. Coordination is critical to restarts of NAVAID services and to the establishment of any special procedures for the movement of aircraft. All relocation or adjustments to NAVAIDs, or changes to final grades in critical areas, should be coordinated with FAA ATO and may require an FAA flight inspection prior to restarting the facility. Flight inspections must be coordinated and scheduled well in advance of the intended facility restart.

No adjustments to NAVAID, encroachment on facility critical areas, or facility shutdowns are anticipated during construction, so ATO coordination will not be necessary.

e. Pre-Paving Meeting. If paving is included in this project, a pre-paving meeting will be held to discuss the status of preliminary submittals, the RPR's inspection of the plant and laboratory, test section requirements, paving plan requirements, and production requirements.

f. Payment. The cost of complying with the requirements of this section, including but not limited to scheduling; providing flag people; construction, maintenance and removal of temporary access roads and staging areas; providing, placing, relocating, maintaining and removing temporary barricades; providing and placing permanent barricades; protection of aircraft and vehicular traffic; installation, maintenance and removal of temporary airfield markings; maintenance of airport lighting circuits; installation, maintenance, and removal of temporary wiring and airfield lighting facilities; cleaning of paved surfaces; restoration of surfaces disturbed as a result of the Contractor's operations; providing, maintaining, and removing warning signs, hazard markings, barricade lights; providing, maintaining, and removing temporary access gates; providing padlocks for access gates; providing a guard at access gates; and all security requirements shall be included under Technical Specification Item C-106, Safety, Security and Maintenance of Traffic.

3.2 PHASING.

a. Phase Elements (Work Areas)

1. Work Area Descriptions: The work of the project has been divided into areas in order to coordinate construction in a way that will minimize interference with Airport operations:

Work Area "A" and Phase 1: Includes demolition of existing fuel farm, including canopy, fuel equipment, and existing fuel tanks.

Work Area "B": Includes installation of a new drainage system for the final site. The scope in this area must be completed concurrent with phases 1, 2 & 3 based on the location of the work.

Work Area "C" and Phase 2: Includes construction of the new SRE building expansion.

Work Area "D" and Phase 3: Includes demolition of site pavement and final paving of the site.

2. Construction Safety Requirements

The Contractor shall obtain approval from the RPR prior to beginning any work in all areas of the airport. No work is expected on runways or taxiways during this project. No active runway or taxiway shall be crossed, entered, or obstructed at any time. The Contractor shall plan and coordinate his/her work in such a manner as to insure safety and a minimum of hindrance to airport operations. All Contractor equipment and material stockpiles shall be stored at locations determined during construction or as shown on the Construction Safety Drawings (Appendix 1). No equipment will be allowed to park within the approach area of an active runway at any time.

During the work under this Contract, the Airport Owner will make such arrangements to coordinate aircraft movements and Airport operations as necessary to conform to the construction procedures as outlined below and as shown on the Contract Drawings. The Contractor shall give adequate notice to the RPR, so as to afford time to coordinate construction with the Airport Owner. No work shall proceed in any area without prior approval.

The Contractor shall always confine construction operations to the Contractor work area and designated haul routes. Contractor personnel, equipment, stored materials, subcontractors and suppliers will not be allowed on any other area within the Air Operations Area and within the Airport boundaries without prior approval of the Airport Owner or RPR.

The RPR will perform a visual site assessment before the Contractor occupies the Contractor work area. The Contractor shall be held responsible for all repairs and cleanup costs incurred as a result of the Contractor's construction operations. Restoration shall be the complete return of all work areas to the original conditions.

Temporary cables in grass areas shall be marked with stakes and flagging. Temporary cables in paved areas shall be marked with barricades.

Prior to the start of construction operations, the Contractor shall perform the following:

- Coordinate issuing Notices to Airmen (NOTAM) with the Airport Owner and RPR for the construction activities involved at least 48 hours in advance of the work.

At the conclusion of construction operations, the Contractor shall perform the following:

- Remove barricades, temporary jumpers and closed runway markings, as indicated on the Construction Safety Drawings.
- Clean all paved surfaces in accordance with Item C-106, Safety, Security and Maintenance of Traffic.
- Coordinate cancellation of the NOTAMs with the Airport Owner and RPR.

3. **Failure to Complete on Time.** For each partial calendar day or partial working day, as specified in the contract, that any work remains uncompleted after the contract time (including all extensions and adjustments as provided in the subsection titled DETERMINATION AND EXTENSION OF CONTRACT TIME of this Section) the sum of $2,000 will be deducted from any money due or to become due the Contractor or his/her surety. Such deducted sums shall not be deducted as a penalty but shall be considered as liquidation of a reasonable portion of damages including but not limited to additional engineering services that will be incurred by the Airport Owner should the Contractor fail to complete the work in the time provided in his/her contract.

The work of this Contract and time charged shall commence on the date stated in the written Notice to Proceed. The Contract Time shall be **259 WORKING DAYS** and means that all of the work of the Contract is complete and in operating order.

The work of this Contract and time charged shall commence on the date stated in the written Notice to Proceed. The time of completion for each work area is shown below, and means that all of the work of the Contract for each work area is complete and in operating order.

Phase 1 (Work Area A)	30 WORKING DAYS
Work Area B	CONCURRENT WITH PHASES 1 AND 2
Substantial Completion for Operational Facility Work	**OCTOBER 18, 2024**
Phase 2 (Work Area B, C)	199 WORKING DAYS
Phase 3 (Work Area D)	30 WORKING DAYS

Time charged against the first work area shall begin on the date stated in the written Notice to Proceed. Time charged against subsequent work areas shall begin on the date and time stated in the NOTAMS issued for closure of the affected Work Area, at which time the Contractor may begin to place barricades, temporary jumpers, etc. for that Work Area.

Time charged against an individual Work Area shall end when the RPR deems that work is substantially complete. Substantial completion of work in an individual Work Area is defined as the Work Area being fully operational and open to aircraft traffic, all barricades affecting the Work Area are removed, all

temporary jumpers affecting the Work Area are removed, all pavements in the Work Area are cleaned, and NOTAMS affecting the completed Work Area are cancelled.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a wavier on the part of the Airport Owner of any of its rights under the contract.

b. Construction Safety Drawings. Drawings specifically indicating operational safety procedures and methods in affected areas (i.e., construction safety drawings) have been developed for each construction phase. Such drawings are included in the CSPP as referenced attachments and are included in the contract drawing package.

3.3 AREAS AND OPERATIONS AFFECTED BY THE CONSTRUCTION ACTIVITY.

Contractor, subcontractor, and supplier employees or any other unauthorized persons shall be restricted from entering an active airport operating area without previous permission from the Airport Owner and the Aircraft Control Tower.

In an emergency situation, the Airport Owner or other designated airport representative may order the Contractor to suspend operations; move personnel, equipment, and materials to a safe location; and stand by until aircraft use is completed.

The Contractor shall cooperate with the airport users through the RPR, in coordination with airport operations, in scheduling the operations to provide adequate clearance for safe aircraft parking, fueling, maintenance, loading or unloading, maneuvering, taxing operations, or other aircraft operations.

a. Mitigation of effects.

This CSPP has established specific requirements and operational procedures necessary to maintain the safety and efficiency of airport operations during the construction of this project.

All coordination pertaining to airport operations during construction will go through the Airport Owner's Representative and the Airport Operations Manager. Any required NOTAM's to be issued will be sent through the Airport Owner's Representative and issued by Airport Operations.

2. **Detours for ARFF and other airport vehicles:** The project work site shall remain open to all ARFF vehicles in emergency situations. The Contractor is required to maintain access in and around the project work area for all ARFF vehicles. Proper routing of this traffic will be effectively communicated to all supervisory personnel involved in the construction project.

3. **Maintenance of essential utilities:** Special attention shall be given to preventing unscheduled interruption of utility services and facilities. Where required due to construction purposes, the Airport Owner and FAA shall locate all of their underground utilities. It is the Contractor's responsibility to have the locations of cabling and other underground utilities marked prior to beginning excavation. Any locations provided by the Airport Owner or FAA are approximate locations and the Contractor shall verify all locations prior to beginning excavations. When an underground cable or utility is damaged due to the Contractor's negligence the Contractor shall immediately repair the affected cable or utility at his/her own expense. Full coordination between airport staff, field inspectors, and construction personnel will be exercised to ensure that all airport power and control cables are fully protected prior to any excavation.

3.4 NAVIGATION AID (NAVAID) PROTECTION.

Before commencing construction activity, parking vehicles, or storing construction equipment and materials near a NAVAID, coordinate with the appropriate FAA ATO/Technical Operations office to evaluate the effect of construction activity and the required distance and direction from the NAVAID. Construction activities, materials/equipment storage, and vehicle parking near electronic NAVAIDs require special consideration since they may interfere with signals essential to air navigation. Construction activities, materials/equipment storage, and vehicle parking near electronic NAVAIDs are not anticipated in this project.

3.5 CONTRACTOR ACCESS.

This section of the CSPP details the areas to which the Contractor must have access, and how Contractor personnel will access those project work areas.

a. Location of stockpiled construction materials.

The Contractor shall store material and equipment and schedule his operations for work to be done so that no unauthorized interference to normal Airport operations will result there from. Construction operations shall not be conducted in a manner to cause interference with Airport Operations. Stockpiled materials and equipment storage are not permitted within the Runway Safety Area/ Taxiway Safety Area (RSA/TSA), Obstacle Free Zone (OFZ) or Object Free Area (OFA) of an operational runway or taxiway. Stockpiled construction materials must be located inside the Contractor staging area as shown on the Construction Safety Drawings (Appendix 1) unless otherwise approved by the RPR.

Stockpiled material shall be constrained in a manner to prevent movement resulting from either aircraft jet blast or wind conditions in excess of ten miles per hour. In addition, stockpiled material shall have silt fence located around the material to prevent Foreign Object Debris (FOD) from moving onto the airfield pavements or polluting watercourses.

Open trenches exceeding 3 inches in depth and 5 inches in width or stockpiled material are not permitted within the limits of safety areas of operational runways or taxiways. Stockpiled material shall not be permitted within the protected areas of the runways, or allowed to penetrate into any of the protected airspace.

Spoil and Disposal Areas: Spoil shall be disposed of onsite in accordance with the Airport Authorities unless otherwise shown or specified. The Contractor shall submit the "Spoils Deposition Release Form" for any spoils which are transported from the project site. A copy of the form can be found in Appendix 4. No direct payment will be made for spoiling and disposal operations. The cost of spoiling material on site, or of spoiling material off-site, shall be considered incidental to this Contract and the costs shall be included in the various pay items involved.

b. Vehicle and pedestrian operations. <u>Vehicle and pedestrian access routes for airport construction projects must be controlled to prevent inadvertent or unauthorized entry of persons, vehicles, or animals onto the Air Operations Area (AOA).</u>

The Airport Owner will coordinate requirements for vehicle operations with the affected airport tenants. Specific vehicle and pedestrian requirements for this project are as follows:

All construction vehicles and personnel shall be restricted to the immediate work areas specified by the contract for this project. These areas include the haul routes into the work area, the designated Contractor

staging area and the apron area under construction. Use of alternate haul routes or staging areas by the Contractor shall not be permitted without prior notification and approval by the Airport Owner's Representative.

1. Construction Site Parking:

The Contractor's personal vehicle parking area shall be in the Field Maintenance Public Parking, as shown on the Construction Safety Drawings (Appendix 1). Contractor personal vehicles will not be allowed inside the airport fence Air Operations Area (AOA) or secured area.

A staging area, as indicated on the Contract Drawings, will be provided where the Contractor may set up a field office and store equipment and materials. The Contractor shall make his own arrangements for, and bear all costs of required utilities. The Contractor shall use and maintain the site in accordance with requirements of the Airport Owner. Upon completion of work, the Contractor's staging area shall be removed and the area cleaned and restored to original or better condition.

2. Construction Equipment Parking:

The Contractor's equipment storage area shall be in the Contractor staging area as shown on the Construction Safety Drawings (Appendix 1). The Contractor's equipment and construction vehicles shall be restricted to the construction site or storage areas during construction and parked in the equipment storage area during non-working periods. Maximum allowable equipment height in the staging area shall be 25 feet. Maximum allowable equipment height in the work areas shall be 25 feet (50 feet for crane), unless otherwise noted. Maximum allowable equipment height at the spoil area shall be 25 feet.

Contractor must service all construction vehicles within the limits of the project work area or the Contractor's Staging Area. Parked construction vehicles must be outside the OFA and never in the safety area of an active runway or taxiway. Inactive equipment must not be parked on closed taxiways or runways. If it is necessary to leave specialized equipment on a closed taxiway or runway at night, the equipment must be well lighted. Employees shall also park construction vehicles outside the OFA when not in use by construction personnel (for example, overnight, on weekends, or during other periods when construction is not active). Parking areas must not obstruct the clear line of sight by the ATCT, as applicable, to any taxiways or runways under air traffic control nor obstruct any runway visual aids, signs, or navigation aids.

3. Access and Haul Roads:

The Contractor shall clear, construct and maintain haul routes as required for the prosecution of the work. The haul routes and access points shall only be in the locations approved by the RPR and the Airport Owner or as shown on the Construction Safety Drawings (Appendix 1).

Access or haul routes used by Contractor vehicles must be clearly marked to prevent inadvertent entry to areas open to airport operations. Construction traffic must remain on the designated haul routes, never straying from the approved paths. Haul and access routes shall be clearly delineated with temporary marking and signage by the Contractor. Signage and marking placement shall be reviewed and approved by the RPR and Airport Owner prior to being put into service. The Contractor shall fully describe the appropriate access routes to all his/her employees, subcontractors and material delivery personnel.

The Contractor shall be responsible for maintaining existing haul routes. At the completion of the project, these areas shall be returned to their original lines and grades and shall be restored to a condition equal to or better than original. All non-paved areas that are disturbed by Contractor's haul

roads, staging area, etc., located outside of the seeding limits shown on the plans shall be re-seeded and restored to their original or better condition by the Contractor at no additional cost to the Airport Owner.

The Contractor shall coordinate haul routes, closures and schedules with other projects which may be underway during the same time period as this contract.

The Contractor shall control and coordinate the material (supplies) that are hauled to and from work area. Delivery of equipment and materials to the area of work shall be by way of the access route shown on the Construction Safety Drawings (Appendix 1) or designated by the Airport Owner or RPR. The airport reserves the right to deduct from the contract time spent by Airport, Tenant, Vendor or Consultant Staff to direct deliveries to the appropriate area.

The Contractor shall maintain all haul routes and work areas in a dust free condition at all times. The Contractor shall control dust from the construction operations by vacuum type sweeping, watering or other methods as approved by the RPR. Contractor shall have equipment (in operating condition) on site, at all times, to control dust. If the Contractor fails to comply with this requirement, construction will be suspended until a plan for controlling the dust is approved by the RPR. Landside haul routes, boulevards and drives shall be kept clean by use of a vacuum sweeper on a daily basis as required. Application of water on dirt or gravel haul routes must be provided as often as necessary. Haul roads in any airport traffic areas must be especially monitored for dust and debris to prevent any potential Foreign Object Debris (FOD) situations.

The existing perimeter road shall remain open and accessible for airport personnel at all times. Special attention must be given to ensure that if construction traffic is to share or cross any Airport Rescue and Fire Fighting (ARFF) routes that ARFF right of way is not impeded at any time, and that construction traffic on haul roads do not interfere with NAVAIDs or approach surfaces of operational runways.

Portions of the project area(s) shall be bounded by the low-profile barricades identifying Contractor personnel and vehicle area operation limits. The locations of any barricaded project limits, haul routes, Contractor Staging Areas, and associated safety and security details are also provided graphically in the attached exhibits.

4. Marking and Lighting of Vehicles:

When any vehicle or piece of equipment, other than one that has prior approval from the Airport Owner, must operate on an airport, it shall be escorted and properly identified.

The Contractor shall limit access within the airport security fence to authorized vehicles. All authorized vehicles shall have a vehicle dash board placard permit issued by the Airport Owner or an identification sign on both sides of the vehicle containing the Contractor's company name. Private vehicles of the Contractor's personnel must be parked outside the airport security fence and will not be allowed within the airport security fence at any time.

All vehicles operating on the airport and in the general vicinity of the safety area or in aircraft movement areas must be marked with flashing yellow/amber beacons or orange and white flags during daylight hours. During hours of darkness or low visibility they shall be marked with at least flashing yellow/amber beacons.

Each vehicle shall be assigned initials or numbers that are prominently displayed on each side of the vehicle. The identification symbols shall be at least 12-inch high, block-type characters of a contrasting color, and easy to read. They may be applied either by using tape or a water-soluble paint to facilitate removal. Magnetic signs are also acceptable.

Beacons and flags must be maintained to standards and in good working and operational condition. Beacons must be located on the uppermost part of the vehicle structure, visible from any direction, and flash 75 +/- 15 flashes per minute. Flags shall be 3' by 3' with alternating 1' by 1' international orange and white squares, and shall be replaced by the Contractor if they become faded, discolored, or ragged as determined by Airport Operations or the Airport Owner's Representative.

5. Description of Proper Vehicle Operations:

The Contractor shall be required to follow guidance on the additional identification and control of construction equipment per the Airport's Security Plan. No Contractor's vehicle or pedestrian crossing of active runways or taxiways will be allowed at any time during the work of this Contract, unless otherwise specified. No deviation from the pedestrian and vehicle routes to and from the Project Areas will be allowed unless specific permission has been granted by the Airport Owner.

The ground movement of aircraft shall have the right-of-way at all times, and the Contractor's vehicles and equipment shall yield to aircraft at all times.

6. Required Escorts:

Anyone not in possession of a current airport badge shall be escorted by an appropriately badged person. At no time will vehicles or personnel enter portions of the secure AOA outside the contract area unless permitted and accompanied by an airport approved escort.

At no time shall active taxiways or taxilanes be crossed by construction equipment without notification and proper approval/clearance from radio-trained gate guards or Airport Operations.

7. Training Requirements for Vehicle Drivers:

Any employees the Contractor would request to be given permission by Airport Operations to drive on the AOA shall complete airport badging and driver training per the Airport's requirements. These employees then must have an airfield driving experience with Airport Operations and if Airport Operations is satisfied of the employee's competency, that employee may be granted permission from Airport Operations to drive on the AOA. Passing the AOA driver training does not give the Contractor's employees the ability to drive on the AOA.

8. Situational Awareness:

Aircraft traffic will continue to use existing runways, aprons, and taxiways of the Airport during the time that work under a contract is being performed. The Contractor shall, at all time, conduct the work as to create no hindrance, hazard, or obstacle to aircraft using the Airport.

Vehicle drivers must confirm by personnel observation that no aircraft is approaching their position (either in the air or on the ground) when given clearance to cross a runway, taxiway, or any other area open to airport operations. In addition, it is the responsibility of the escort vehicle driver to verify the movement/position of all escorted vehicles at any given time.

9. Two-way Radio Communication Procedures:

Two-way radio communications are not required between Contractors and Airport Traffic Control Tower. Vehicular traffic shall not be allowed in or on an active movement area. Construction

personnel may operate in movement areas provided a NOTAM is issued closing the area, and provided that the area is properly marked to prevent incursions.

10. Maintenance of the Secured Area of the Airport.

Airport Owner and contractors must also maintain a high level of security during construction when access points are created in the security fencing to permit construction vehicle access. Temporary gates shall be equipped and/or manned by construction personnel to prevent unauthorized access by vehicles, animals or people. Procedures conforming to Airport security protocols should be in place to ensure that only authorized persons and vehicles have access to the AOA and to prohibit "piggybacking" behind another person or vehicle. Access shall be made available at all times to all airport emergency vehicles traveling to operations areas within the proximity of the construction work zone.

c. Security.

Each Contractor's employee, subcontractors and their employees will be issued an identification card by the Airport Owner to permit access to secured area. Contractors will be charged two dollars ($2.00) for each card and they shall include the price of this in their bid. Cards shall be returned at the end of the project. In general, security in the construction area is the responsibility of the Contractor.

Please note that badged employees must display badge at all times, on the outermost garment of clothing.

The Contractor shall be responsible for maintaining security at all access gates used during the project and will be held liable by the Airport Owner for any breach of security. No gate shall be left open. [The Contractor shall be required to post a guard at the gate to open and close the gate for personnel and equipment. No gate shall be left open. Guard shall be responsible for ensuring that no unauthorized persons or vehicles enter the secure area. Airport Owner and contractors must take care to maintain security during construction when access points are created in the security fencing to permit the passage of construction vehicles or personnel. Temporary gates shall be equipped so they can be securely closed and locked to prevent access by animals and unauthorized people. Procedures should be in place to ensure that only authorized persons and vehicles have access to the AOA and to prohibit "piggybacking" behind another person or vehicle.

The Contractor shall be required to maintain security and comply with the [Airport Security Plan and the] Transportation Security Administration Security Rules and Regulations throughout the duration of the project. The Contractor and the Surety shall indemnify and save harmless the Airport Owner, RPR and third party or political subdivision from any and all breaches of security and shall indemnify the Airport Owner for any fines, expenses and damages which it may be obliged to pay by reason of any breach of security resulting from the Contractor's actions at any time during the prosecution of the work. Such breaches of security are subject to fines by the Transportation Security Administration of up to ten thousand dollars ($10,000) per incident.

3.6 WILDLIFE MANAGEMENT.

Construction contractors must carefully control and continuously remove waste or loose materials that might attract wildlife. Contractor personnel must be aware of and avoid construction activities that can create wildlife hazards on airports.

a. Trash. Food scraps from construction personnel activity must be collected and disposed of at a proper facility.

b. Standing water. Water shall not be allowed to collect and pool for more than any single 24-hour period. Temporary grading may be required to promote drainage during daily operations as well as between work phases.

c. Tall grass and seeds. The use of millet seed in turfing and seeding operations shall not be permitted.

d. Poorly maintained fencing and gates. The Contractor shall maintain a constant secure perimeter to the airfield, including continuous security perimeter fencing and gates (if applicable).

e. Disruption of existing wildlife habitat. Not applicable to this project.

Contractor shall take immediate remedial action to remove wildlife attractants should any occurrence be noted. Contractor shall immediately report to the RPR and Airport Owner should any wildlife congregation be noted, and in particular if mammals enter the airport through the construction gate.

3.7 FOREIGN OBJECT DEBRIS (FOD) MANAGEMENT.

Special care and measures shall be taken to prevent Foreign Object Debris (FOD) damage when working in an airport environment. Waste and loose materials, commonly referred to as FOD, are capable of causing damage to aircraft landing gears, propellers, and jet engines. The Contractor shall be responsible for implementing an approved FOD Management Plan prior to the start of construction activities. The FOD Management Plan will have procedures for prevention, regular cleanup, and containment of construction material and debris. The Contractor will ensure all vehicles related to the construction project using paved surfaces in the AOA shall be free of any debris that could create a FOD hazard. Special attention will be given to the cleaning of cracks and pavement joints. All taxiways, aprons, and runways must remain clean. Waste containers with attached lids shall be required on construction sites.

Special attention should be given to securing lightweight construction material (concrete insulating blankets, tarps, insulation, etc.). Specific securing procedures and/or chainlink enclosures may be required.

Contractors will provide their own equipment for vehicle and equipment washing and clean up.

Immediate access to a power sweeper is required when construction occurs on any pavement area inside the AOA, unless an appropriate alternative has been approved by the Airport Owner's Representative and Airport Operations Manager.

3.8 HAZARDOUS MATERIALS (HAZMAT) MANAGEMENT.

Contractors operating construction vehicles and equipment on the airport must be prepared to expeditiously contain and clean-up spills resulting from fuel, hydraulic fluid, or other chemical fluid leaks. Transport and handling of other hazardous materials on an airport also requires special procedures. To that end, the Contractor is required to develop a spill prevention plan and response procedures for vehicle operations prior to the start of construction activities. This includes maintenance of appropriate MSDS data and appropriate prevention and response equipment on-site.

Fueling Procedures and Spill Recovery Procedures shall be in accordance with Michigan Fire Code, latest edition, and the National Fire Protection Association standard procedures for spill response, latest edition. If fueling is to take place in the staging area, it must be away from catch basins. Contractor must have spill containment kits on site.

In the event of a fuel spill or the spill of other hazardous materials, the Contractor shall immediately notify the Airport Owner and the RPR, the Michigan Department of Environment, Great Lakes, and Energy (EGLE), the Environmental Protection Agency, and the Airport Communications Center (616-233-6055).

Contractor shall abide by the specific requirements contained in the Technical Specifications of this contract.

3.9 NOTIFICATION OF CONSTRUCTION ACTIVITY.

The following is information and procedures for immediate notification of airport users and the FAA of any conditions adversely affecting the operational safety of the airport.

a. Maintenance of a list of Responsible Representatives/ Point of contact. A list of responsible representatives and points of contact shall be created by the RPR, the Airport and the Contractor prior to the start of construction. This list shall be compiled as part of the project pre-construction meeting agenda. Procedures will be established to contact all parties, including after regular work hours. Updates will be made to the list throughout the project duration by the RPR. Contractor points of contact shall be incorporated into the contractor's SPCD.

b. Notices to Airman (NOTAM). Only the Airport Owner may initiate or cancel NOTAMs on airport conditions, and is the only entity that can close or open a runway or taxiway. The Airport Owner must coordinate the issuance, maintenance, and cancellation of NOTAMs about airport conditions resulting from construction activities with tenants and the local air traffic facility (control tower, approach control, or air traffic control center), and must provide information on closed or hazardous conditions on airport movement areas to the FAA Flight Service Station (FSS) so it can issue a NOTAM. The Airport Owner must file and maintain a list of authorized representatives with the FSS. Only the FAA may issue or cancel NOTAMs on shutdown or irregular operation of FAA owned facilities. Any person having reason to believe that a NOTAM is missing, incomplete, or inaccurate must notify the Airport Owner. See Section 3.14 regarding issuing NOTAMs for partially closed runways versus runways with displaced thresholds.

Any NOTAMs for planned airfield closures for this project must be coordinated through the airport manager and the airports duly appointed construction management representative. Reference Section 3.2 for planned closures for this project, which require issuance of a NOTAM.

c. Emergency Notification Procedures. In the event of an aircraft emergency, severe weather conditions, or any issue as determined by the Airport that may affect aircraft operations, the Contractor's personnel and/or equipment may be required to immediately vacate the area(s) affected. Points of contact for the various parties involved with the project shall be identified and shared at the pre-construction meeting among the various parties. Emergency points of contact shall be incorporated into the contractor's SPCD.

d. Coordination with ARFF Personnel. The Contractor shall coordinate, through the duly appointed airport representative, with ARFF personnel, mutual aid providers and other emergency services if construction requires the following:

- The deactivation and subsequent reactivation of water lines or fire hydrants, or
- The re-routing, blocking and restoration of emergency access routes, or
- The use of hazardous materials on the airfield.

Procedures and methods for addressing any planned or emergency response actions on the airfield concerning this project shall be established and implemented prior to the start of construction.

e. Notification to the FAA.

1. **Part 77.** Any person proposing construction or alteration of objects that affect navigable airspace, as defined in Part 77, must notify the FAA. This includes construction equipment and proposed parking areas for this equipment (i.e. cranes, graders, other equipment) on airports. FAA Form 7460-1, Notice of Proposed Construction or Alteration, is used for this purpose and submitted to the appropriated FAA Airports Regional or District Office. A 7460-1 form for this project has been prepared by the Engineer and submitted to the FAA for using equipment with a maximum height of 50 feet. A new 7460-1 form must be submitted to the FAA for review and comment for any equipment that the Contractor will use which is taller than the equipment used in the above 7460-1 submission. The Airport Owner will be responsible for submitting the new 7460-1 form to the FAA. To that end, the Contractor shall identify the equipment in his SPCD, including the maximum height it will extended to during construction, the area(s) in which the equipment will be used, and the duration the equipment will be used.

2. **Part 157.** It is not anticipated that Part 157 notifications will be required for this project.

3. **NAVAIDS.** For emergency (short-notice) notification about impacts to both airport owned and FAA owned NAVAIDs, contact: 866-432-2622.

   i. **Airport owned/FAA maintained**. If construction operations require a shutdown of more than 24 hours, or more than 4 hours daily on consecutive days, of a NAVAID owned by the airport but maintained by the FAA, provide a 45-day minimum notice to FAA ATO/Technical Operations prior to facility shutdown.

   ii. **FAA owned.** The Airport Owner must notify the appropriate FAA ATO Service Area Planning and Requirements (P&R) Group a minimum of 45 days prior to implementing an event that causes impacts to NAVAIDs. (Impacts to FAA equipment covered by a Reimbursable Agreement (RA) do not have to be reported by the Airport Owner). Coordinate work for an FAA owned NAVAID shutdown with the local FAA ATO/Technical Operations office, through the RPR, including any necessary reimbursable agreements and flight checks. Detail procedures that address unanticipated utility outages and cable cuts that could impact FAA NAVAIDs. In addition, provide seven days' notice to schedule the actual shutdown.

f. Accidents. The Contractor shall provide at the site such equipment and medical facilities as are necessary to supply first aid service to anyone who may be injured in connection with the work. The Contractor must promptly report in writing to the RPR all accidents whatsoever arising out of, or in connection with, the performance for the work, whether on or adjacent to the site which caused death, personal injury or property damages, giving full details and statements of witnesses. In addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the RPR and the Airport Owner.

If any claim is made by anyone against the Contractor or any Subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the RPR giving full details of the claims.

3.10 INSPECTION REQUIREMENTS.

a. Daily (or more frequent) inspections. Inspections shall be conducted by the Contractor at least daily, but more frequently if necessary, to ensure conformance with the CSPP. A sample checklist is provided in Appendix 2 of this document. In addition to Contractor's required inspections, airport operations will inspect the construction site three (3) times a day to ensure compliance with the CSPP and the SPCD. The Airport Owner's Representative will have full-time inspectors monitoring activity throughout construction.

Promptly take all actions necessary to prevent or remedy any unsafe or potentially unsafe conditions as soon as they are discovered.

b. Final inspections. A final inspection with the Airport Owner's Representative, Airport and Contractor will take place prior to allowing airport operations.

3.11 UNDERGROUND UTILITIES.

Special attention shall be given to preventing unscheduled interruption of utility services and facilities. Where required due to construction purposes, the FAA shall locate all of their underground cables. The Contractor shall locate and/or arrange for the location of all the underground cables. When an underground cable is damaged due to the Contractor's negligence the Contractor shall immediately repair the cable affected at his/her own expense. Full coordination between airport staff, field inspectors, and construction personnel will be exercised to ensure that all airport power and control cables are fully protected prior to any excavation. Locations of cabling will be marked prior to beginning excavation.

Prior to opening an excavation, effort shall be made to determine whether underground installation: i.e., sewer, water, fuel, electric lines, etc., will be encountered, and if so, where such underground installations are located. When the excavation approaches the approximate locations of such an installation, the exact locations shall be determined by careful hand probing or hand digging, and/or use of a vacuum truck, and when it is uncovered, adequate protection shall be provided for the existing installation. All known owners of underground facilities in the area concerned shall be advised of proposed work at least 48 hours prior to the start of actual excavation.

The information concerning underground utilities was compiled from information and sketches furnished by or obtained from utility companies and the Airport. The Airport Owner and the RPR do not guarantee their accuracy. The Contractor is advised to determine the exact locations from the available sources of information or provide his own means of detection. The only case in which the RPR will consider redesign or relocation of a proposed facility in the project is when an existing utility is located within the construction limits. In this case, the RPR will work with the Airport Owner to determine the appropriate action to resolve the conflict. If such relocation is impossible, the RPR will consider re-design or relocation of the proposed facilities. In both cases, Contractor shall be responsible for all underground utilities and shall not be separately compensated for delays or extra cost.

Note that most utility location services do not include locating FAA and Airport Owner facilities, and most will not locate services within the AOA.

3.12 PENALTIES.

Failure on the part of the Contractor to adhere to prescribed requirements may have consequences that jeopardize the health, safety or lives of customers and employees at the airport. The Airport may issue warnings on the first offense based upon the circumstances of the incident. Individuals involved in non-compliance violations may be required to surrender their Airport ID badges and/or be prohibited from working at the airport, pending an investigation of the matter.

Penalties for violations related to airport safety and security procedures will be established by the Airport.

Note: project shutdown or misdemeanor citations may be issued on a first offense. When construction operations are suspended, activity shall not resume until all deficiencies are rectified.

3.13 SPECIAL CONDITIONS.

In the event of an aircraft emergency, the Contractor's personnel and/or equipment may be required to immediately vacate the area. The Contractor will receive notification from airport operations when special conditions require the construction site to be vacated. In any event, extreme care should be exercised should construction personnel identify any ARFF (Airport Rescue and Fire-Fighting) or other emergency or rescue vehicle moving toward the Runway with emergency lights displayed. This will generally mean that an emergency situation is imminent.

Special conditions that could require suspension of the construction work include the following: aircraft in distress, aircraft accident, security breach, VIP operation, vehicle/pedestrian deviation, severe weather, or failing to abide by this Construction Safety and Phasing Plan and/or the Safety Plan Compliance Document.

3.14 RUNWAY AND TAXIWAY VISUAL AIDS.

This topic includes marking, lighting, signs, and visual NAVAIDs. Those areas where aircraft will be operating shall be clearly and visibly separated from construction areas, including closed runways. Throughout the duration of the construction project, the Contractor shall inspect and verify that these areas remain clearly marked and visible at all times and that marking, lighting, signs and visual NAVAIDs remain in place and operational.

a. General. Airport markings, lighting, signs, and visual NAVAIDs must be clearly visible to pilots, not misleading, confusing, or deceptive. All must be secured in place to prevent movement by prop wash, jet blast, wing vortices, or other wind currents and constructed of materials that would minimize damage to an aircraft in the event of inadvertent contact.

Marking and lighting for a temporary threshold is not required.

Closed runway markings are not required.

b. Markings. Markings must be in compliance with the standards of AC 150/5340-1, Standards for Airport Markings, current edition, and the drawings and technical specifications of this project.

1. Closed Runways and Taxiways.

(a) Permanently Closed Runways. For permanently closed runways, the threshold marking, runway designation marking, and touchdown zone markings will be removed, and flat yellow closed runway markings (X's) will be placed at each end and at 1,000-foot (300 m) intervals.

(b) Temporarily Closed Runways. For temporarily closed runways, a lighted X will be placed at each end of the runway directly on or as near as practicable to the runway designation numbers. For a multiple runway environment, if the lighted X on a designated number will be located in the RSA of an adjacent active runway, the lighted X will be located farther down the closed runway to clear the RSA of the active runway. In addition, the closed runway numbers located in the RSA of an active runway will be marked with a flat yellow X.

(c) Partially Closed Runways and Displaced Thresholds. When threshold markings are needed to identify the temporary beginning of the runway that is available for landing, the markings will comply with AC 150/5340-1. An X will not be used on a partially closed runway or a runway with a displaced threshold. Because of the temporary nature of the threshold relocation or displacement due to construction, it will not be necessary to re-adjust the existing runway centerline markings to meet standard spacing for a runway with a visual approach.

(1). Partially Closed Runways. Pavement markings for temporary closed portions of the runway will consist of a runway threshold bar, runway designation, and yellow chevrons

to identify pavement areas that are unsuitable for takeoff or landing. Markings prior to the moved threshold will be obliterated or covered. Existing touchdown zone markings beyond the moved threshold may remain in place. Aiming point markings will be obliterated.

(2). Displaced Thresholds. Pavement markings for a displaced threshold will consist of a runway threshold bar, runway designation, and white arrowheads with and without arrow shafts. These markings are required to identify the portion of the runway before the displaced threshold to provide centerline guidance for pilots during approaches, takeoffs, and landing rollouts from the opposite direction. Markings prior to the displaced threshold will be obliterated. Existing touchdown zone markings beyond the displaced threshold may remain in place. Aiming point markings will be obliterated.

(d). Permanently Closed Taxiways. Permanently closed taxiways will be either be removed, or if pavement will remain, an X will be placed at the entrance to both ends of the closed section. Taxiway centerline markings, including runway leadoff lines, leading to the closed taxiway will be obliterated.

(e). Temporarily Closed Taxiways. . Barricades will be placed outside the safety area of intersecting taxiways. For runway/taxiway intersections, an X will be placed at the entrance to the closed taxiway from the runway. Taxiway centerline markings, including runway leadoff lines and taxiway to taxiway turns, leading to the closed section, will be obliterated if the taxiway will be closed for an extended period. Runway lead-off lines for high speed exits will always be obliterated, regardless of the duration of the closure.

c. Lighting and visual NAVAIDs. This paragraph refers to standard runway and taxiway lighting systems. When runway and taxiway lighting fixtures need to be disconnected, disconnect the associated isolation transformers. Alternately, the light fixture may be covered in such a way as to prevent light leakage. Lamp shall not be removed from energized fixtures. Amu above ground temporary wiring shall be secure, identified, and placed in conduit to prevent electrocution and fire ignition sources. At towered airports certificated under Part 139, holding position signs shall be illuminated on open taxiways crossing to closed or inactive runways. If the holding position sign is installed on the runway circuit for the closed runway, a temporary jumper shall be installed to the taxiway circuit to provide power to the holding position sign for nighttime operations.

(1). Permanently Closed Runways and Taxiways. For runways and taxiways that have been permanently closed, the associated lighting circuits shall be disconnected.

(2). Temporarily Closed Runways and New Runways Not Yet Open to Air Traffic. A lighted X shall be used, both at night and during the day, placed at each end of the runway on or near the runway designation numbers facing the approach. (Note: the lighted X must be illuminated at all times that it is on a runway.) For runways that have been temporarily closed, but for an extended period, and for those with pilot controlled lighting, the lighting circuits shall be disconnected or switches secured to prevent inadvertent activation. Stop bars shall be activated, if available.

(3). Partially Closed Runways and Displaced Thresholds. When a runway is partially closed, a portion of the pavement is unavailable for any aircraft operation, meaning taxiing and landing or taking off in either direction. A displaced threshold, by contrast, is put in place to ensure obstacle clearance by landing aircraft. The pavement prior to the displaced threshold is available for takeoff in the direction of the displacement, and for landing and takeoff in the opposite direction. Misunderstanding this difference and issuance of a subsequently inaccurate NOTAM can result in a hazardous situation. For both partially closed runways and displaced thresholds, approach lighting systems at the affected end must be placed out of service.

(a) Partially Closed Runways. Runway edge and threshold lights shall be disconnected on that part of the runway at and behind the threshold (that is, the portion of the runway that is closed).

(b) Temporary Displaced Thresholds. Edge lighting in the area of the displacement shall emit red light in the direction of approach and yellow light (white for visual runways) in the opposite direction. If the displacement is 700 feet or less, centerline lights shall be blanked out in the direction of approach or the centerline lights shall be placed out of service. If the displacement is over 700 feet, the centerline lights shall be placed out of service.

(c) Temporary runway thresholds and runway ends must be lighted if the runway is lighted and it is the intended threshold for night landings or instrument meteorological conditions.

(d). A temporary threshold on an unlighted runway will be marked by retroreflective, elevated markers. Markers seen by aircraft on approach are green. Markers at the rollout end of the runway are red. At certificated airports, temporary elevated threshold markers must be mounted with a frangible fitting (see 14 CFR Part 139.309). At non-certificated airports, the temporary elevated threshold markings may either be mounted with a frangible fitting or be flexible.

(e). Temporary threshold lights and runway end lights and related visual NAVAIDs will be installed outboard of the edges of the full-strength pavement only when they cannot be installed on the pavement. They are installed with bases at grade level or as low as possible, but not more than 3 inch (7.6 cm) above ground. (The standard above ground height for airport lighting fixtures is 14 inches (35 cm)). When any portion of a base is above grade, place properly compacted fill around the base to minimize the rate of gradient change so aircraft can, in an emergency, cross at normal landing or takeoff speeds without incurring significant damage.

(f). Maintain threshold and edge lighting color and spacing standards as described in AC 150/5340-30. Battery powered, solar, or portable lights that meet the criteria in AC 150/5345-50 may be used. These systems are for visual flight rules (VFR) aircraft operations.

(g). When runway thresholds are temporarily displaced, yellow lenses (caution zone) on runway edge lights shall be reconfigured, as necessary.

(h). Visual Glide Slope Indicator (VGSI), such as Visual Approach Slope Indicator (VASI) and Precision Approach Path Indicator (PAPI); other airport lights, such as Runway End Identifier Lights (REIL); and approach lights will be relocated to identify the temporary threshold. The VGSI or any equipment that would give misleading indications to pilots as to the new threshold location may be disabled. Installation of temporary visual aids may be necessary to provide adequate guidance to pilots on approach to the affected runway.

(4). Temporarily Closed Taxiways. If possible, the taxiway lighting circuits will be deactivated. When deactivation is not possible (for example other taxiways on the same circuit are to remain open), the closed portion shall be temporarily disconnected and a temporary jumper will be installed to keep the remaining circuit active. An alternative is to cover the light fixtures in the closed area in a way as to prevent light leakage.

d. Signs. Signs must be in conformance with AC 150/5345-44, Specification for Runway and Taxiway Signs and AC 150/5340-18, Standard for Airport Sign Systems, current edition.

(1). Existing Signs. Runway exit signs are to be covered for closed runway exits. Outbound destination signs are to be covered for closed runways. Any time a sign does not serve its normal function or would provide conflicting information, it must be covered or removed to prevent misdirecting pilots. Note that information signs identifying a crossing taxiway continue to perform their normal function even if the crossing taxiway is closed. For long term construction projects, consider relocating signs, especially runway distance remaining signs.

(2) Temporary Signs. Orange construction signs comprise a message in black on an orange background. Orange construction signs may help pilots be aware of changed conditions. The airport operator may choose to introduce these signs as part of a movement area construction project to increase situational awareness when needed. Locate signs outside the taxiway safety limits and ahead of construction areas so pilots can take timely action. Use temporary signs judiciously, striking a balance between the need for information and the increase in pilot workload. When there is a concern of pilot "information overload," the applicability of mandatory hold signs must take precedence over orange construction signs recommended during construction. Temporary signs must meet the standards for such signs in Engineering Brief 93, Guidance for the Assembly and Installation of Temporary Orange Construction Signs. Many criteria in AC 150/5345-44, Specification for Runway and Taxiway Signs, are referenced in the Engineering Brief. Permissible sign legends are:

1. CONSTRUCTION AHEAD,
2. CONSTRUCTION ON RAMP, and
3. RWY XX TAKEOFF RUN AVAILABLE XXX FT.

Phasing, supported by drawings and sign schedule, for the installation of orange construction signs must be included in the CSPP or SPCD.

e. Testing of Airport Lighting Circuits. The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the RPR. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the RPR. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor shall provide such temporary lights and cables as required to maintain use of existing airfield lighting circuits. Temporary above ground lighting cables, if approved, shall be installed in conduit, and delineated with stakes and flagging. The test equipment for insulation resistance shall be an insulation resistance tester (1,000V megger) with a digital readout. The instrument shall provide a 500 volt test for insulation resistance with a meter range of 0 to 500 megohms.

Earth resistance testing methods shall be submitted to the RPR for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the RPR. All such testing shall be at the sole expense of the Contractor.

Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The RPR shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

Test Requirements Prior to Construction.

i. Test all circuits within the work area for continuity and insulation resistance to ground, at the electrical building, in the presence of the RPR.

ii. Provide a copy of the test results to the RPR.

iii. Check that all circuits are properly connected in accordance with applicable wiring diagrams.

Test Requirements During Construction. Circuit testing during construction shall be as directed and witnessed by the RPR when the Contractor is working on existing circuitry or excavating adjacent to or near existing circuitry. Circuit testing during construction will not be required during the times when the Contractor's operations do not effect existing airfield lighting circuitry. It is the intent of this section to ensure that airfield lighting circuitry remains operational throughout the duration of the Contract.

i. Test all circuits within the work area for continuity and insulation resistance to ground at the electrical building, prior to energizing any circuit.

ii. Insure that all circuits within the work area are operational, prior to the Contractor leaving the project at the end of the work day. Specific times for circuit checks will be determined by the RPR relative to the Contractor's work hours each day.

iii. Segment test new non-grounded series circuits during installation. Length of cable segment tested shall not have more than five (5) splices, light units and/or electrical equipment between the ends being tested. Insulation resistance to ground shall be not less than 500 megohms.

iv. Insure that the insulation resistance to ground of each segment of new non-grounded conductors of multiple conductor circuits is not less than 500 megohms.

v. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes or equipment. The fall-of-potential ground impedance test shall be utilized, as described by ANSI/IEEE Standard 81, to verify this requirement. Ground rods testing higher than 25 ohms shall have a minimum extension of two feet of ground rod added, driven to the proper elevation and re-tested. Extensions shall be attached by exothermic methods and re-testing performed until the tests show 25 ohms resistance or less. Tests shall not be performed within 72 hours after a rain storm has ended or when standing water is present around the ground rod.

vi. Insure that all circuits are properly connected in accordance with applicable wiring diagrams.

vii. The Contractor shall test all circuits within the work area for continuity after backfilling cable trenches. The reading shall be logged and provided to the RPR prior to payment of cable items.

viii. Provide a copy of all test results to the RPR on a daily basis.

After installation, the Contractor shall test and demonstrate to the satisfaction of the RPR the following:

i. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

ii. That all affected circuits (existing and new) are free from unspecified grounds.

iii. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 50 megohms. Verify continuity of all series airfield lighting circuits prior to energization. The Contractor shall be responsible for maintaining an insulation resistance of 50 megohms minimum, with isolation transformers connected, in new circuits and new segments of existing circuits through the end of the contract warranty period.

iv. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

v. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

vi. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

vii. That all original lighting power and control circuits are continuous and insulation resistance to ground is not lower than before construction.

viii. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the RPR prior to performing the testing.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the RPR. Where connecting new cable to existing cable, insulation resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved "repair" procedures for items that have failed testing other than complete replacement.

3.15 MARKING AND SIGNS FOR ACCESS ROUTES.

Location of haul routes on the airport site shall be as specified in the project drawing set and as provided graphically in the attached exhibits, reference Appendix 1. It shall be the Contractor's responsibility to coordinate off-site haul routes with the appropriate owner who has jurisdiction over the affected route. The haul routes, to the extent possible, shall be marked and signed in accordance with FAA airfield signage requirements, the Federal Highway Administration Manual on Uniform Traffic Control Devices (MUTCD) and/or state highway specifications, as applicable.

3.16 HAZARD MARKING, LIGHTING AND SIGNING.

a. Purpose. Hazard marking, lighting, and signing prevent pilots from entering areas closed to aircraft, and prevent construction personnel from entering areas open to aircraft. The CSPP specifies prominent, comprehensible warning indicators for any area affected by construction that is normally accessible to aircraft, personnel, or vehicles. Hazard marking and lighting is also be specified to identify open manholes, small areas under repair, stockpiled material, waste areas, and areas subject to jet blast. Also included are markings to identify FAA, airport, and National Weather Service facilities cables and power lines;

instrument landing system (ILS) critical areas; airport surfaces, such as RSA, OFA, and OFZ; and other sensitive areas to make it easier for contractor personnel to avoid these areas.

b. Equipment.

(1). Barricades. Low profile barricades, including traffic cones, (weighted or sturdily attached to the surface) are acceptable methods used to identify and define the limits of construction and hazardous areas on airports. Careful consideration must be given to selecting equipment that poses the least danger to aircraft but is sturdy enough to remain in place when subjected to typical winds, prop wash and jet blast. The spacing of barricades must be such that a breach is physically prevented barring a deliberate act. Gaps between barricades must be smaller than the width of the excluded vehicles, generally 4 feet (1.2 meters). Provision must be made for ARFF access if necessary. Barricades intended to exclude pedestrians must be continuously linked.

(2) Lights. Lights must be red, either steady burning or flashing, and must meet the luminance requirements of the State Highway Department. Batteries powering lights will last longer if lights flash. Lights must be mounted on barricades and spaced at no more than 10 feet (3 meters). Lights must be operated between sunset and sunrise and during periods of low visibility whenever the airport is open for operations. They may be operated by photocell, but this may require that the contractor turn them on manually during periods of low visibility during daytime hours.

(3) Supplement Barricades with Signs (for example) As Necessary. Examples are "No Entry" and "No Vehicles."

(4). Air Operations Area – General. Barricades are not permitted in any active safety area or on the runway side of a runway hold line. Within a runway or taxiway object free area, and on aprons, use flashing or steady burning red lights as noted above, highly reflective collapsible barricades marked with diagonal, alternating orange and white stripes; and/or signs to separate all construction/maintenance areas from the movement area. Barricades may be supplemented with alternating orange and white flags at least 20 by 20 inch (50 by 50 cm) square and securely fastened to eliminate FOD. All barricades adjacent to any open runway or taxiway/taxilane safety area, or apron must be no more than 18 inches high, exclusive of supplementary lights and flags. Barricades must be of low mass; easily collapsible upon contact with an aircraft or any of its components; and weighted or sturdily attached to the surface to prevent displacement from prop wash, jet blast, wing vortex, and other surface wind currents. If affixed to the surface, they must be frangible at grade level or as low as possible, but not to exceed 3 inch (7.6 cm) above the ground.

(5). Air Operations Area – Runway/Taxiway Intersections. Use highly reflective barricades with lights to close taxiways leading to closed runways. Close all taxiway/runway intersections with barricades. The use of traffic cones is appropriate for short duration closures.

(6). Air Operations Area – Other. Beyond runway and taxiway object free areas and aprons, barricades intended for construction vehicles and personnel may be many different shapes and made from various materials, including railroad ties, sawhorses, jersey barriers, or barrels.

(7). Maintenance. The contractor is required to maintain the hazard markings, lighting and signing and to have a person on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades. The contractor must file the contact person's information with the airport operator. Lighting should be checked for proper operation at least once per day, preferably at dusk.

3.17 WORK ZONE LIGHTING FOR NIGHTTIME CONSTRUICTION. Lighting equipment must adequately illuminate the work area if the construction is to be performed during nighttime hours. All support equipment, except haul trucks, should be equipped with artificial illumination to safely illuminate the area

immediately surrounding their work areas. The lights should be positioned to provide the most natural color illumination and contrast with a minimum of shadows. The spacing must be determined by trial. Light towers should be positioned and adjusted to aim away from ATCT cabs and active runways to prevent blinding effects. Shielding may be necessary. Light towers should be removed from the construction site when the area is reopened to aircraft operations. Construction lighting units should be identified and generally located on the construction phasing plans in relationship to the ATCT and active runways and taxiways. The Owner and the ATCT shall approve the location of and aiming of lighting equipment before it is used.

3.18 PROTECTION OF AIRFIELD AREAS.

Safety area encroachments, improper ground vehicle operations and unmarked or uncovered holes and trenches in the vicinity of aircraft operation surfaces and construction areas are the three most recurring threats to safety during construction. Protection of runway and taxiway safety areas, object free areas, obstacle free zones, and approach/departure surfaces shall be a standing requirement for the duration of construction operations.

3.19 OTHER LIMITATIONS ON CONSTRUCTION.

a. Prohibitions. The following prohibitions are in effect for the duration of this project:

1. No use of tall equipment (cranes, concrete pumps, and so on) unless a 7460-1 determination letter is issued for such equipment.
2. No use of open flame welding or torches unless fire safety precautions are provided and the Airport Owner has approved their use.
3. No use of electrical blasting caps or explosives of any kind on or within 1,000 ft (300 m) of the airport property.

b. Restrictions.

1. Construction suspension required during specific airport operations: Not Applicable
2. Areas that cannot be worked on simultaneously: Not Applicable
3. Day or night construction restrictions: Not Applicable
4. Seasonal Construction Restrictions: Not Applicable
5. Temporary signs not approved by the airport operator.
6. Grade changes that could result in unplanned effects on NAVAIDs.

APPENDIX 1

LOCATION MAP
(Sheet G1.1of the Contract Drawings)

GENERAL PLAN
(Sheet GC 101 of the Contract Drawings)

CONSTRUCTION SAFETY DRAWINGS
(Sheets GC 100 - GC 104 of the Contract Drawings)

CONSTRUCTION SAFETY DETAILS
(Sheet GC 501 of the Contract Drawings)

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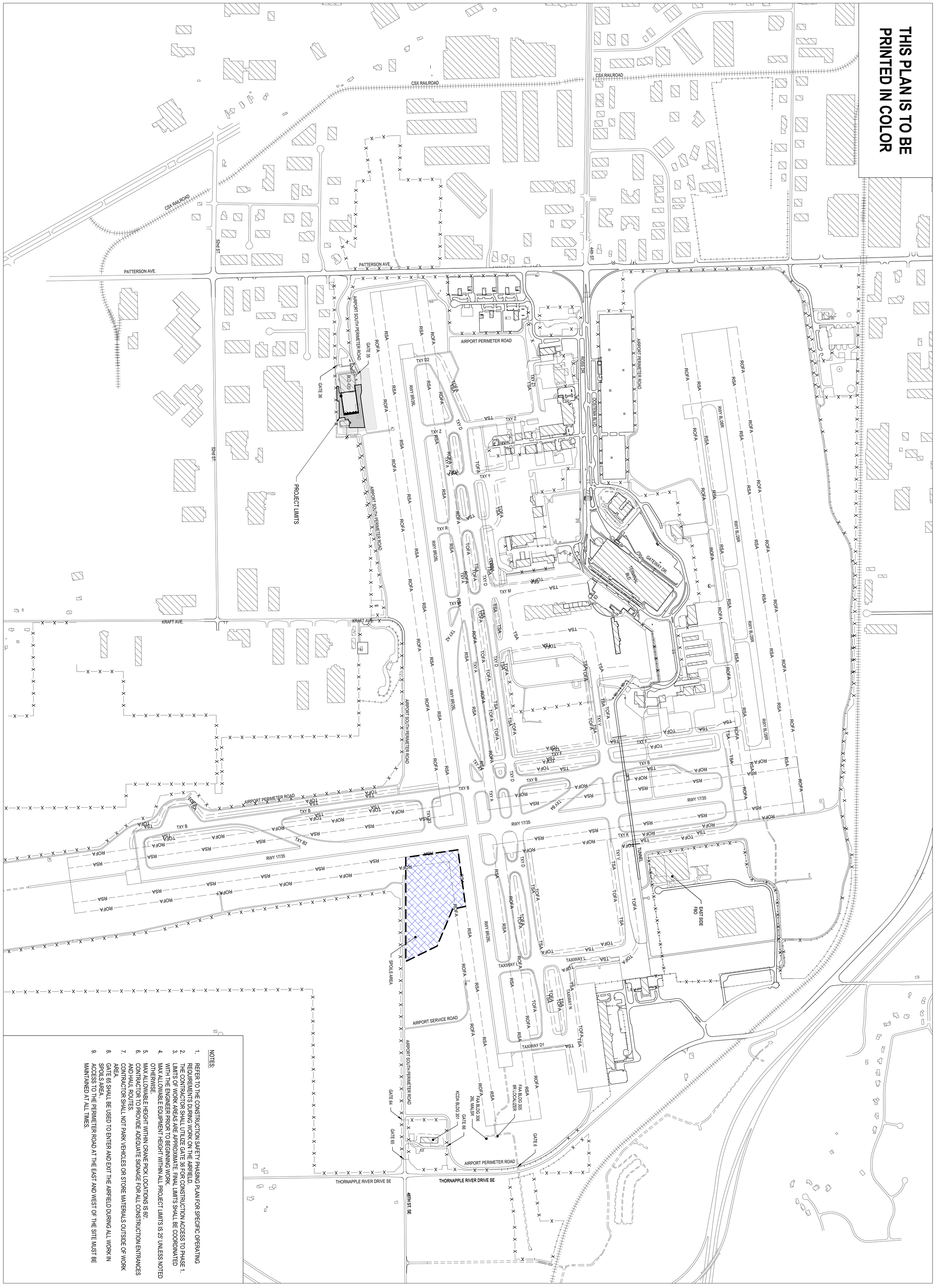
THIS PLAN IS TO BE PRINTED IN COLOR

NORTH

1 **GENERAL PLAN**
SCALE: 1" = 500'



NOTES:

1. REFER TO THE CONSTRUCTION SAFETY PHASING PLAN FOR SPECIFIC OPERATING REQUIREMENTS DURING WORK ON THE AIRFIELD.
2. THE CONTRACTOR SHALL UTILIZE GATE 36 FOR CONSTRUCTION ACCESS TO PHASE 1.
3. LIMITS OF WORK AREAS ARE APPROXIMATE. FINAL LIMITS SHALL BE COORDINATED WITH THE ENGINEER PRIOR TO BEGINNING WORK.
4. MAX ALLOWABLE EQUIPMENT HEIGHT WITHIN ALL PROJECT LIMITS IS 25' UNLESS NOTED OTHERWISE.
5. MAX ALLOWABLE HEIGHT WITHIN CRANE PICK LOCATIONS IS 60'.
6. CONTRACTOR TO PROVIDE ADEQUATE SIGNAGE FOR ALL CONSTRUCTION ENTRANCES AND HAUL ROUTES.
7. CONTRACTOR SHALL NOT PARK VEHICLES OR STORE MATERIALS OUTSIDE OF WORK AREA.
8. GATE 65 SHALL BE USED TO ENTER AND EXIT THE AIRFIELD DURING ALL WORK IN SPOILS AREA.
9. ACCESS TO THE PERIMETER ROAD AT THE EAST AND WEST OF THE SITE MUST BE MAINTAINED AT ALL TIMES.

500' 0 500 1000FT.

DRAWING NUMBER	GI101
	CIVIL

GERALD R. FORD INTERNATIONAL AIRPORT
SRE BUILDING EXPANSION

GENERAL PLAN

DRAWN: GCH	CHK'D: MDH
DESIGNED: RDM	
APPRV'D: MDH	
DATE: SEPTEMBER 18, 2023	
PROJECT NUMBER	2241.7462.00

NO.	REVISION	DATE

ISSUED FOR BID

STATE OF MICHIGAN · MICHAEL D. HAUGHEY · ENGINEER · NO. 6201057571 · REGISTERED PROFESSIONAL ENGINEER

C&S Engineers, Inc.
38777 Six Mile Road, Suite 202
Livonia, Michigan 48152
Phone: 734-953-2571
Fax: 734-206-7973
www.cscos.com

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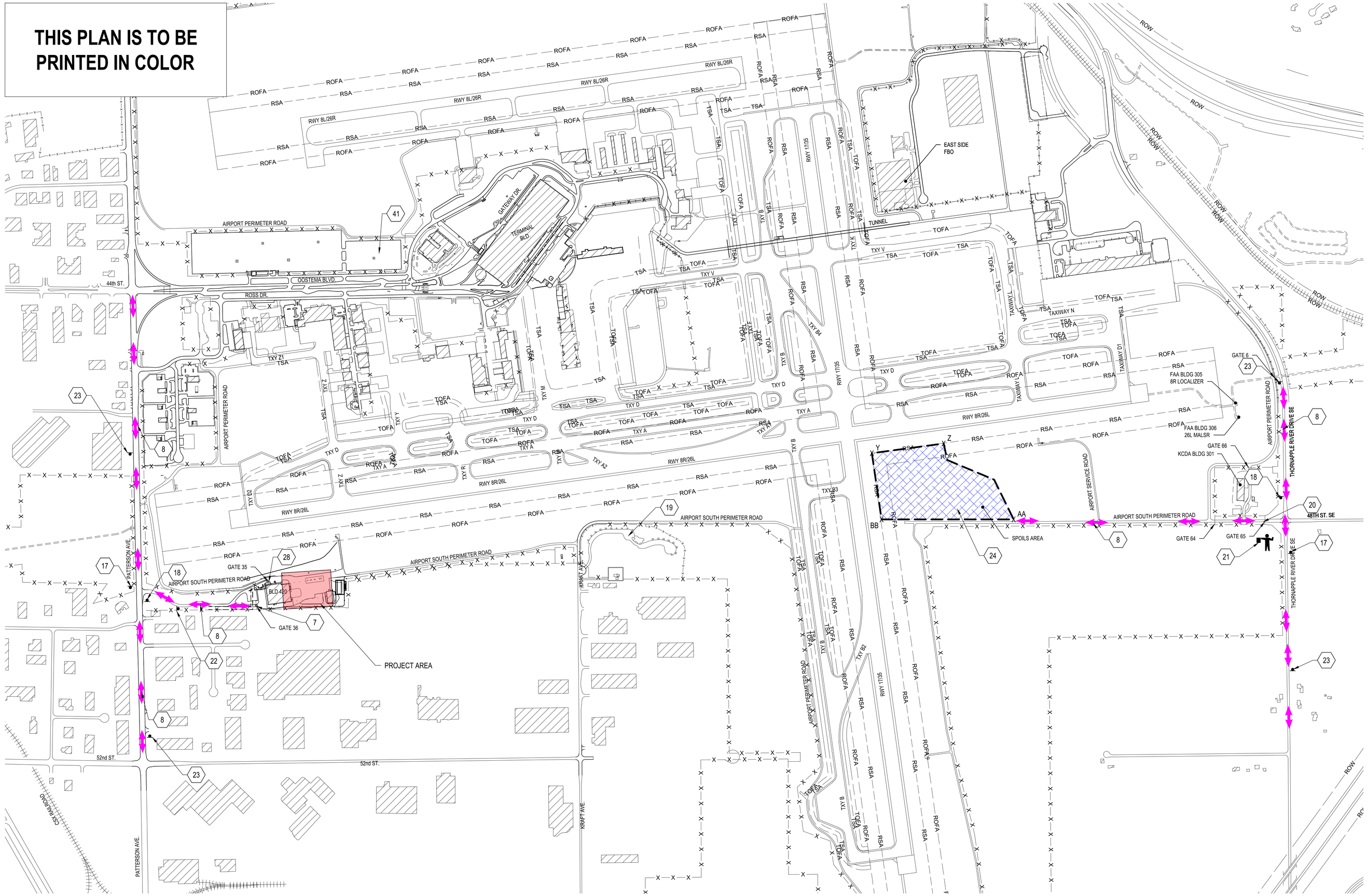

1 **CONSTRUCTION SAFETY PHASING PLAN - ACCESS PLAN**
SCALE: 1" = 500'
NORTH

KEYED NOTES

7. CONTRACTOR SHALL UTILIZE GATE 36 TO ACCESS SRE PROJECT
8. CONTRACTOR'S HAUL ROUTE
17. CONSTRUCTION PROJECT LOCATION SIGN, DETAIL 6/GC501
18. CONSTRUCTION PROJECT LOCATION SIGN, DETAIL 5/GC501
19. CONTRACTOR EMPLOYEES SHALL NOT BE ALLOWED TO PARK PERSONAL VEHICLES AT AIRPORT VIEWING AREAS AT ANY TIME
20. CONTRACTOR SHALL UTILIZE GATE 65 TO ACCESS SPOILS AREA
21. AOA ACCESS POINT TO SPOILS AREA THRUQH EXISTING SWING GATE. ONLY BADGED DRIVERS CAN ACCESS GATE. A CONTRACTOR PROVIDED GATE GUARD AND MANUAL GATE ARM EXTENDING THE FULL WIDTH OF THE GATE OPENING SHALL BE PROVIDED BY THE CONTRACTOR AT THIS LOCATION ANYTIME THE CONTRACTOR IS WORKING AND USING THE GATE. CONTRACTOR SHALL COORDINATE GATE GUARD SECURITY WITH ONGOING CONSTRUCTION EFFORTS FROM OTHER PROJECTS AT THE AIPRORT. COST SHALL BE INCLUDED IN THE ALLOWANCE FOR SECURITY SERVICES AT SPOILS AREA GATE. SEE SPECIFICATION 012100 ALLOWANCES.
22. CONSTRUCTION PROJECT LOCATION SIGN, DETAIL 4/GC501
23. CONSTRUCTION VEHICLES ENTERING SIGN, DETAIL 3/GC501
24. PROPOSED SPOILS AREA, FINAL LOCATION TO BE APPROVED BY THE RPR, (MAXIMUM ALLOWABLE HEIGHT IN SPOILS AREA SHALL BE 25'), COORDINATE OPERATIONS WITH OTHER PROJECT CONTRACTORS
28. CONTRACTOR SHALL ALLOW AIRPORT TRAFFIC ACCESS TO GATE 35 AT ALL TIMES
41. CONTRACTOR SHALL SHUTTLE EMPLOYEES FROM A SEPARATE AIRPORT OVERFLOW PARKING LOT (WELSH ROAD, 3.5 MILES AWAY) TO BE CONFIRMED BY THE OWNER IF ADDITIONAL PARKING REQUIRED.

SHEET NOTES:

1. PRIOR TO CONSTRUCTION, CONTRACTOR AND RPR SHALL VIDEOTAPE / PHOTOGRAPH ALL HAUL ROADS TO BE USED DURING THE PROJECT. THE INFORMATION SHALL BE PROVIDED TO THE OWNER PRIOR TO NOTICE TO PROCEED. ANY DAMAGE TO THE PAVEMENT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO REPAIR, PER RPR. ALL COSTS SHALL BE RESPONSIBILITY OF THE CONTRACTOR.
2. THE CONTRACTOR SHALL GIVE WAY TO AIRPORT TRAFFIC AT ALL TIMES DURING THE PROJECT.
3. THE CONTRACTOR SHALL NOT LEAVE THE LIMITS OF WORK AND THE DESIGNATED HAUL ROUTES AS SHOWN ON THE CONTRACT DOCUMENTS UNLESS OTHERWISE AUTHORIZED BY AIRPORT PERSONNEL.
4. CONTRACTOR EMPLOYEES SHALL NOT BE ALLOWED TO PARK PERSONAL VEHICLES AT AIRPORT VIEWING AREAS AT ANY TIME.

500 0 500 1000FT.
500'

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38777 Six Mile Road, Suite 202
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Phone: 734-953-2571
Fax: 734-206-7973
www.cscos.com

STATE OF MICHIGAN
MICHAEL D. HOLDWICK
ENGINEER
NO. 6201057577
PROFESSIONAL ENGINEER

ISSUED FOR BID

NO.	REVISION	DATE

DRAWN: GCH CHK'D: MDH
DESIGNED: RDM
APPR'VD: MDH
DATE: SEPTEMBER 18, 2023
PROJECT NUMBER 2241.7462.00

GERALD R. FORD INTERNATIONAL AIRPORT
SRE BUILDING EXPANSION

CONSTRUCTION SAFETY PHASING PLAN - ACCESS PLAN

DRAWING NUMBER GC100

CIVIL

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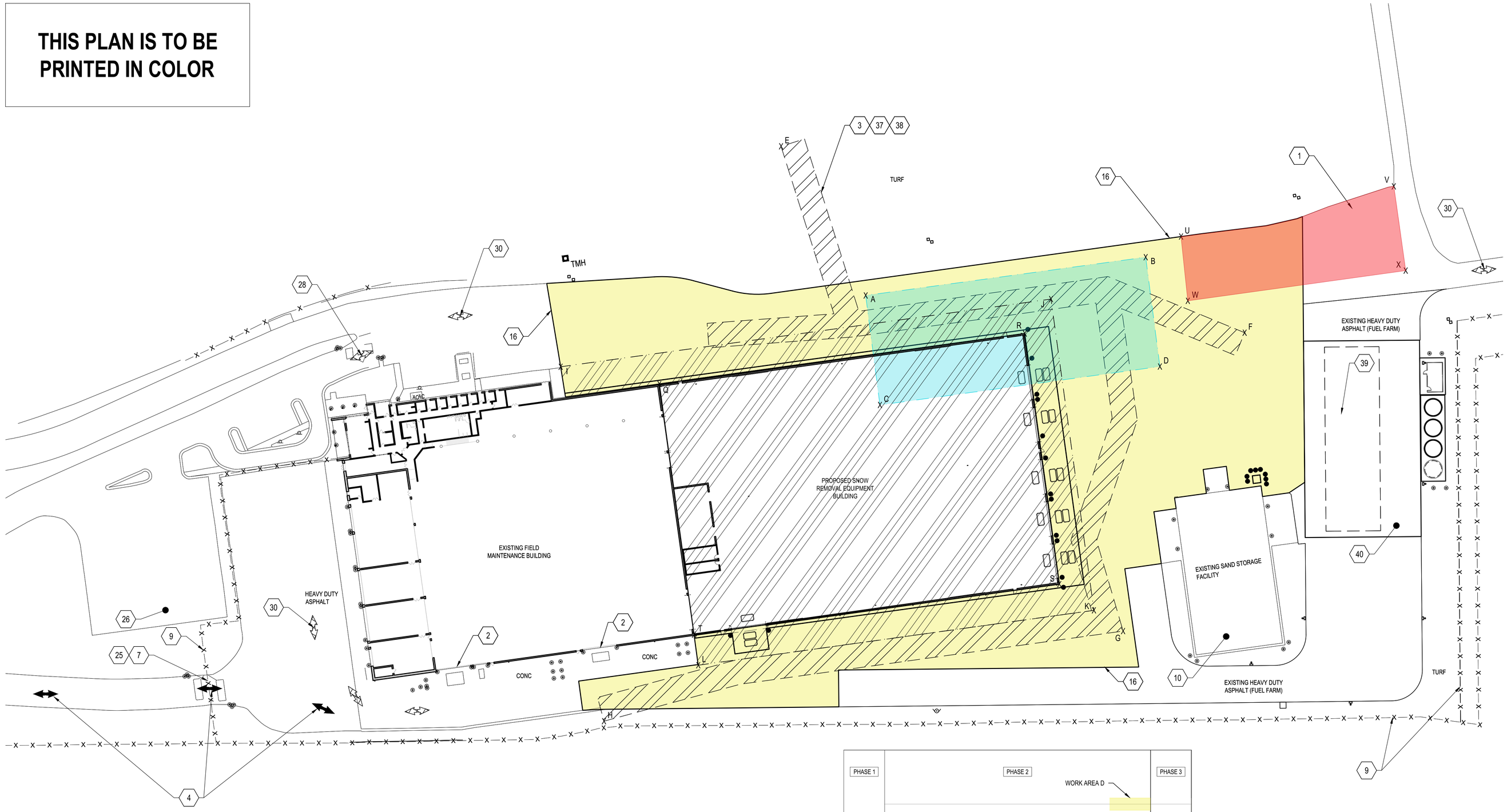
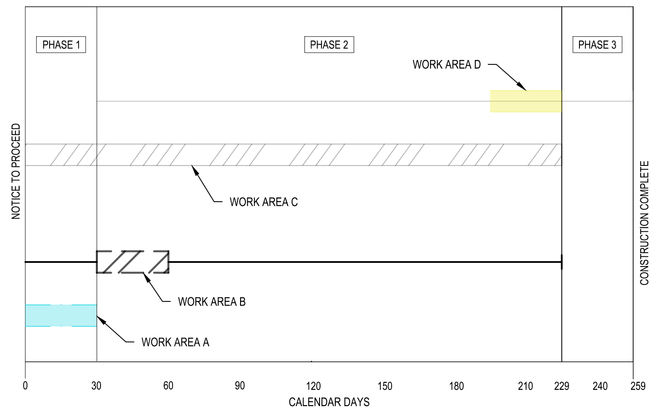


TOTAL CONTRACT TIME - 259 CALENDAR DAYS

- PHASE 1 (WORK AREA A, B, C) 30 DAYS
- PHASE 2 (WORK AREA B, C, D) 199 DAYS
- PHASE 3 (WORK AREA D) 30 DAYS
- ANTICIPATED NOTICE TO PROCEED MARCH 4, 2024
- SUBSTANTIAL COMPLETION FOR OPERATIONAL FACILITY USE OCTOBER 18, 2024



NORTH

1 CONSTRUCTION SAFETY PHASING PLAN - OVERALL PLAN
SCALE: 1" = 40'

WORK AREA A						
POINT NO.	NORTHING	EASTING	LATITUDE	LONGITUDE	GROUND ELEV.	MAX HEIGHT
A	503,212.93	12,808,923.83	N42° 52' 29.36"	W85° 32' 23.26"	789.26	25'
B	503,244.08	12,809,151.91	N42° 52' 29.70"	W85° 32' 20.21"	790.81	25'
C	503,123.72	12,808,935.44	N42° 52' 28.48"	W85° 32' 23.09"	789.11	25'
D	503,155.03	12,809,163.49	N42° 52' 28.82"	W85° 32' 20.04"	790.86	25'

WORK AREA B						
POINT NO.	NORTHING	EASTING	LATITUDE	LONGITUDE	GROUND ELEV.	MAX HEIGHT
E	503,334.42	12,808,854.89	N42° 52' 30.55"	W85° 32' 24.21"	779.17	25'
F	503,182.57	12,809,232.52	N42° 52' 29.10"	W85° 32' 19.11"	790.16	25'
G	502,939.51	12,809,133.53	N42° 52' 26.69"	W85° 32' 20.40"	791.19	25'
H	502,866.11	12,808,710.64	N42° 52' 25.90"	W85° 32' 26.06"	790.34	25'

WORK AREA C & TEMPORARY CRANE						
POINT NO.	NORTHING	EASTING	LATITUDE	LONGITUDE	GROUND ELEV.	MAX HEIGHT
I	503,154.83	12,808,675.35	N42° 52' 28.75"	W85° 32' 26.59"	790.17	60'
J	503,209.97	12,809,074.77	N42° 52' 29.35"	W85° 32' 21.24"	791.19	60'
K	502,956.42	12,809,109.77	N42° 52' 26.85"	W85° 32' 20.72"	791.19	60'
L	502,911.72	12,808,787.45	N42° 52' 26.36"	W85° 32' 25.04"	789.99	60'

WORK AREA D						
POINT NO.	NORTHING	EASTING	LATITUDE	LONGITUDE	GROUND ELEV.	MAX HEIGHT
M	503,222.71	12,808,664.04	N42° 52' 29.42"	W85° 32' 26.76"	788.69	25'
N	503,277.16	12,809,279.62	N42° 52' 30.04"	W85° 32' 18.50"	789.52	25'
O	502,910.21	12,809,146.23	N42° 52' 26.40"	W85° 32' 20.22"	0.00	25'
P	502,874.99	12,808,693.31	N42° 52' 25.99"	W85° 32' 26.30"	789.18	25'

FUEL FARM CANOPY & CHEMICAL TANKS						
POINT NO.	NORTHING	EASTING	LATITUDE	LONGITUDE	GROUND ELEV.	MAX HEIGHT
Q	503,140.71	12,808,755.75	N42° 52' 28.62"	W85° 32' 25.51"	790,16	25'
T	502,936.67	12,808,784.00	N42° 52' 26.61"	W85° 32' 25.09"	790.19	25'
R	503,181.90	12,809,053.41	N42° 52' 29.07"	W85° 32' 21.52"	790.93	25'
S	502,977.75	12,809,081.59	N42° 52' 27.06"	W85° 32' 21.10"	791.51	25'

SPOILS AREA POINTS						
POINT NO.	NORTHING	EASTING	LATITUDE	LONGITUDE	GROUND ELEV.	MAX HEIGHT
AA	503,858.49	12,816,890.46	N42° 52' 36.82"	W85° 30' 36.39"	782.00	25'
BB	503,858.49	12,815,407.48	N42° 52' 36.62"	W85° 30' 56.31"	782.00	25'
Y	504,601.72	12,815,298.89	N42° 52' 43.94"	W85° 30' 57.91"	782.00	25'
Z	504,710.36	12,816,104.83	N42° 52' 45.13"	W85° 30' 47.10"	782.00	25'

2 AIRSPACE ANALYSIS
SCALE: NOT TO SCALE

KEYED NOTES

1. CONTRACTOR STAGING AREA
2. SOUTH EXISTING MAINTENANCE FACILITY DOORS TO REMAIN OPERATIONAL AT ALL TIMES DURING CONSTRUCTION
3. CONTRACTOR TO COORDINATE UTILITY WORK WITH AIRPORT. CONTRACTOR TO PROVIDE A MINIMUM TWO WEEK NOTICE FOR ANY UTILITY WORK THAT WILL INTERUPT AIRPORT ACCESS TO AND FROM MAINTENANCE FACITLITY
4. CONTRACTOR VEHICLE ACCESS ROUTE TO PROJECT SITE. CONTRACTOR SHALL GIVE RIGHT OF WAY TO AIRPORT OPERATIONS VEHICLES AT ALL TIMES
7. CONTRACTOR SHALL UTILIZE GATE 36 TO ACCESS SRE PROJECT
9. EXISTING FENCE
10. EXISTING SAND STORAGE BUILDING
16. APPROXIMATE CONSTRUCTION LIMITS
25. PERSONAL VEHICLES CANNOT BE PARKED WITHIN LOCATION INSIDE THE SECURED AREA.
26. CONTRACTOR EMPLOYEE PARKING (UP-TO 10 SPACES ONLY), REFER TO CSPP. SEE NOTES 5 AND 6 THIS SHEET
28. CONTRACTOR SHALL ALLOW AIRPORT TRAFFIC ACCESS TO GATE 35 AT ALL TIMES
30. AIRPORT OPERATIONS VEHICLE ROUTES TO AIRFIELD
37. CONTRACTOR SHALL BACKFILL ALL TRENCHES TO EXISTING GRADE EACH DAY TO ALLOW AIRPORT TRAFFIC TO CROSS
38. CONTRACTOR SHALL PLACE BARRICADES AROUND ALL OPEN TRENCHES AND UNEVEN SURFACES AT ALL TIMES
39. FUEL FARM FACILITY (BY OTHERS). ANTICIPATED COMPLETION DATE DECEMBER 1, 2023.
40. EXISTING CONCRETE PAVEMENT (FUEL FARM)

SHEET NOTES:

1. PRIOR TO CONSTRUCTION, CONTRACTOR AND RPR SHALL VIDEOTAPE / PHOTOGRAPH ALL HAUL ROADS TO BE USED DURING THE PROJECT. THE INFORMATION SHALL BE PROVIDED TO THE OWNER PRIOR TO NOTICE TO PROCEED. ANY DAMAGE TO THE PAVEMENT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO REPAIR, PER RPR. ALL COSTS SHALL BE RESPONSIBILITY OF THE CONTRACTOR.
2. CONTRACTOR TO COORDINATE UTILITY WORK WITH AIRPORT. CONTRACTOR TO PROVIDE A MINIMUM TWO WEEK NOTICE FOR ANY UTILITY WORK THAT WILL INTERRUPT AIRPORT ACCESS TO AND FROM MAINTENANCE FACILITY.
3. THE CONTRACTOR SHALL GIVE WAY TO AIRPORT TRAFFIC AT ALL TIMES DURING THE PROJECT.
4. THE CONTRACTOR SHALL NOT LEAVE THE LIMITS OF WORK AREAS AND THE DESIGNATED HAUL ROUTES AS SHOWN ON THE CONTRACT DOCUMENTS UNLESS OTHERWISE AUTHORIZED BY AIRPORT PERSONNEL.
5. CONTRACTOR SHALL SHUTTLE EMPLOYEES FROM A SEPARATE AIRPORT OVERFLOW PARKING LOT (WELSH ROAD, 3.5 MILES AWAY) TO BE CONFIRMED BY THE OWNER IF ADDITIONAL PARKING REQUIRED. SEE GC100.
6. CONTRACTOR EMPLOYEES SHALL NOT BE ALLOWED TO PARK PERSONAL VEHICLES AT AIRPORT VIEWING AREAS AT ANY TIME.

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38777 Six Mile Road, Suite 202
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Fax: 734-206-7973
www.cscos.com

STATE OF MICHIGAN
MICHAEL D. HOLDWICK
ENGINEER
NO. 6201057577
PROFESSIONAL ENGINEER

ISSUED FOR BID

NO.	REVISION	DATE

DRAWN: GCH | CHK'D: MDH
DESIGNED: RDM
APPRV'D: MDH
DATE: SEPTEMBER 18, 2023
PROJECT NUMBER: 2241.7462.00

GERALD R. FORD INTERNATIONAL AIRPORT
SRE BUILDING EXPANSION

CONSTRUCTION SAFEFTY PHASING PLAN - OVERALL PLAN

DRAWING NUMBER: GC101 | CIVIL

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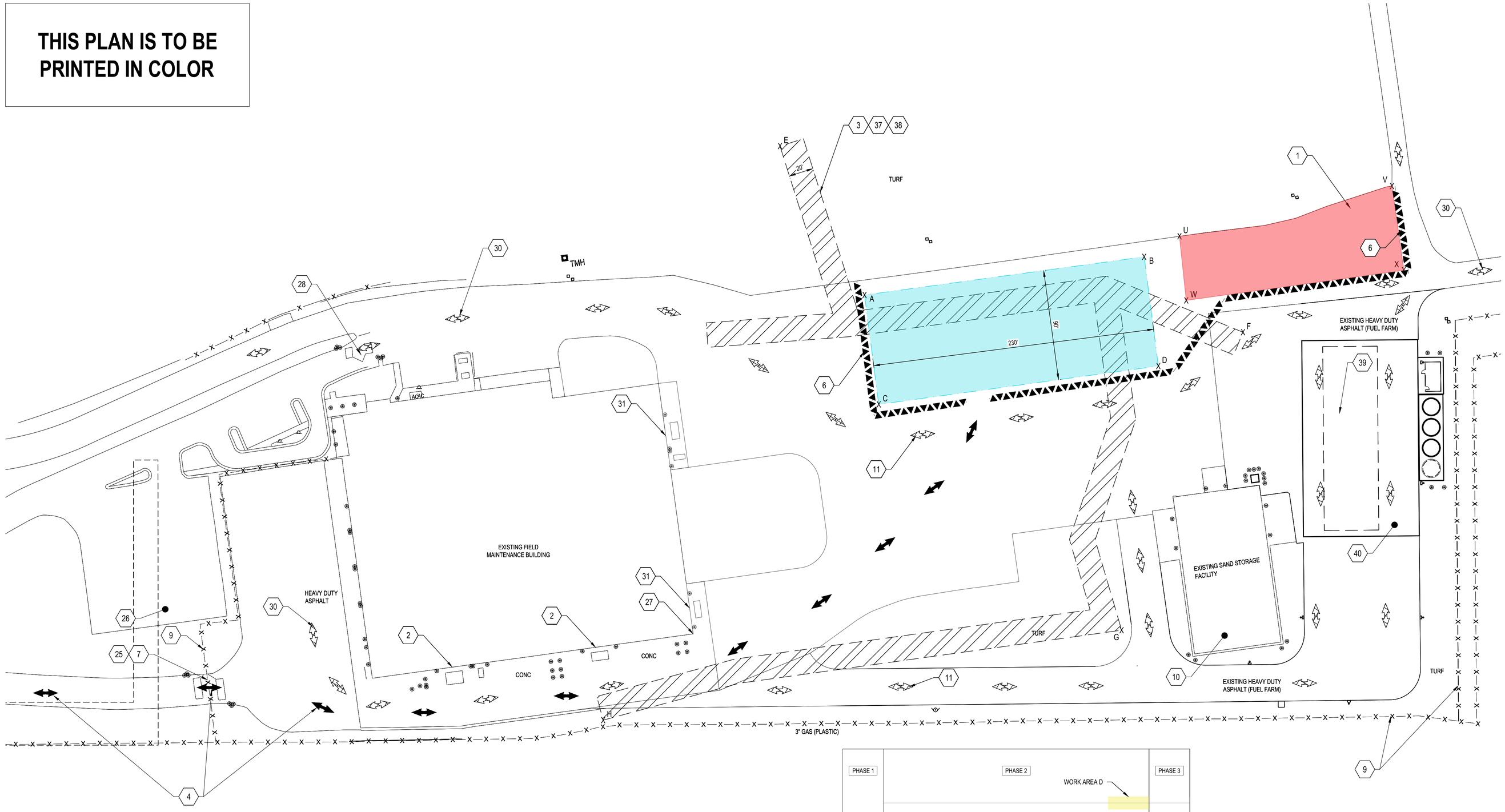

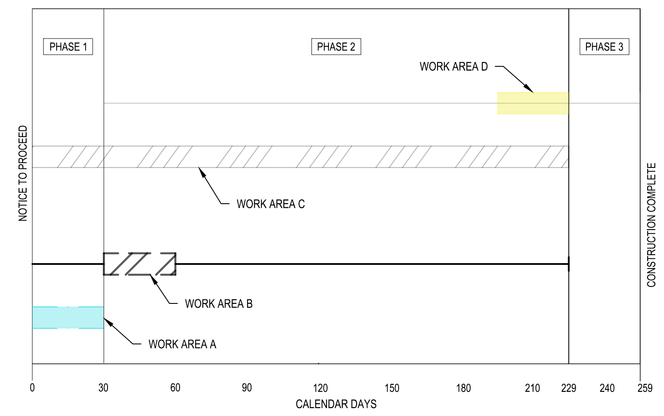

TOTAL CONTRACT TIME - 259 CALENDAR DAYS

- PHASE 1 (WORK AREA A, B, C) 30 DAYS
- PHASE 2 (WORK AREA B, C, D) 199 DAYS
- PHASE 3 (WORK AREA D) 30 DAYS
- ANTICIPATED NOTICE TO PROCEED MARCH 4, 2024
- SUBSTANTIAL COMPLETION FOR OPERATIONAL FACILITY USE OCTOBER 18, 2024

1 CONSTRUCTION SAFETY PHASING PLAN - PHASE 1

SCALE: 1" = 40'

NORTH

PHASE 1 (WORK AREA A) - 30 CALENDAR DAYS

PHASE 1 WILL INCLUDE DEMOLITION OF EXISTING FUEL FARM, INCLUDING CANOPY, FUEL EQUIPMENT, AND EXISTING FUEL TANKS

CONSTRUCTION:

- DISASSEMBLE CANOPY, EXISTING DISPENSERS, TANKS, LIGHT POLES, BOLLARDS, PIPE EQUIPMENT, PUMP SHED
- REMOVE EXISTING CONCRETE PAVEMENT
- EXCAVATE AND REMOVE EXISTING UNDERGROUND STORAGE TANKS
- BACKFILL EXCAVATED TANKS WITH SUITABLE BORROW MATERIAL
- REMOVE EXISTING PAVEMENT AND CURB
- CONTRACTOR SHALL BACKFILL AND COMPACT TRENCH AS INSTALLATION PROGRESSES TO RESTORE AIRPORT VEHICULAR TRAFFIC

TRAFFIC IMPACTS:

- FUELING TO TAKE PLACE AT NEW FUELING FACILITY EAST OF SAND STORAGE BUILDING
- CLOSED SECTION OF LOT TO BE BARRICADED OFF 10' FROM EDGE OF DEMOLISHED PAVEMENT
- CONTRACTOR SHALL BACKFILL AND COMPACT TRENCH AS INSTALLATION PROGRESSES TO RESTORE AIRPORT VEHICULAR TRAFFIC
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO EAST DOORS OF EXISTING MAINTENANCE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO EXISTING SAND STORAGE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO NEW FUEL FACILITY AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS TO GATE 35 AT ALL TIMES.

PHASE 1 (WORK AREA B)

THE SCOPE IN THIS AREA MUST BE COMPLETED CONCURRENT WITH PHASES 1 & 2 BASED ON THE LOCATION OF THE WORK. WORK AREA B WILL INCLUDE INSTALLATION OF NEW DRAINAGE SYSTEM FOR THE FINAL SITE.

CONSTRUCTION:

- INSTALL NEW DRAINAGE SYSTEM THROUGHOUT SITE.
- BACKFILL AND COMPACT DRAINAGE SYSTEM TO EXISTING GRADE TO RESTORE AIRPORT VEHICLE TRAFFIC

TRAFFIC IMPACTS:

- CONTRACTOR SHALL BACKFILL AND COMPACT TRENCH AS INSTALLATION PROGRESSES TO RESTORE AIRPORT VEHICULAR TRAFFIC
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO EXISTING MAINTENANCE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO EXISTING SAND STORAGE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO NEW FUEL FACILITY AT ALL TIMES
- CONTRACTOR SHALL BARRICADE ALL OPEN TRENCHES AT ALL TIMES

PHASE 1 (WORK AREA C)

PHASE 2 WILL INCLUDE CONSTRUCTION OF THE NEW SRE BUILDING. THIS WORK AREA MAY BEGIN CONCURRENT WITH PHASES 1 & 2 BASED ON THE LOCATION OF THE WORK.

CONSTRUCTION:

- FULL DEPTH REMOVAL OF EXISTING PAVEMENT
- REMOVAL OF EXISTING ELECTRICAL CABLE AND CONDUIT
- REMOVAL OF EXISTING DRAINAGE
- REMOVAL OF EXISTING CONCRETE APRONS
- REMOVAL OF EXISITNG BOLLARDS AND DOOR LOOPS
- CONSTRUCTION OF PROPOSED SRE BUILDING
- INSTALL AND CONNECT ROOF DRAINS

TRAFFIC IMPACTS:

- CONTRACTOR SHALL BARRICADE 25' OFFSET FROM EDGE OF BUILDING
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO SOUTH DOORS OF MAINTENANCE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO EXISTING SAND STORAGE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO NEW FUEL FACILITY AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS TO GATE 35 AT ALL TIMES.
- CONTRACTOR SHALL INSTALL NECESSARY STORM WATER PUMPS TO DRAIN LOW POINTS ON THE SITE

KEYED NOTES

1. CONTRACTOR STAGING AREA
2. SOUTH EXISTING MAINTENANCE FACILITY DOORS TO REMAIN OPERATIONAL AT ALL TIMES DURING CONSTRUCTION
3. CONTRACTOR TO COORDINATE UTILITY WORK WITH AIRPORT. CONTRACTOR TO PROVIDE A MINIMUM TWO WEEK NOTICE FOR ANY UTILITY WORK THAT WILL INTERUPT AIRPORT ACCESS TO AND FROM MAINTENANCE FACITLITY
4. CONTRACTOR VEHICLE ACCESS ROUTE TO PROJECT SITE. CONTRACTOR SHALL GIVE RIGHT OF WAY TO AIRPORT OPERATIONS VEHICLES AT ALL TIMES
6. TEMPORARY BARREL BARRICADES, SEE DETAIL 1/GC501
7. CONTRACTOR SHALL UTILIZE GATE 36 TO ACCESS SRE PROJECT
9. EXISTING FENCE
10. EXISTING SAND STORAGE BUILDING
11. AIRPORT OPERATIONS VEHICLE ROUTES DURING PHASE 1 CONSTRUCTION
25. PERSONAL VEHICLES CANNOT BE PARKED WITHIN LOCATION INSIDE THE SECURED AREA.
26. CONTRACTOR EMPLOYEE PARKING (UP-TO 10 SPACES ONLY). REFER TO CSPP. SEE NOTES 5 AND 6 THIS SHEET
27. CONTACTOR SHALL ALLOW AIRPORT ACCESS TO WASH DOWN AREA AT ALL TIMES.
28. CONTRACTOR SHALL ALLOW AIRPORT TRAFFIC ACCESS TO GATE 35 AT ALL TIMES
30. AIRPORT OPERATIONS VEHICLE ROUTES TO AIRFIELD
31. EAST EXISTING MAINTENANCE FACILITY DOORS TO REMAIN OPERATIONAL AT ALL TIMES DURING PHASE 1 CONSTRUCTION
37. CONTRACTOR SHALL BACKFILL ALL TRENCHES TO EXISTING GRADE EACH DAY TO ALLOW AIRPORT TRAFFIC TO CROSS
38. CONTRACTOR SHALL PLACE BARRICADES AROUND ALL OPEN TRENCHES AND UNEVEN SURFACES AT ALL TIMES
39. FUEL FARM FACILITY (BY OTHERS). ANTICIPATED COMPLETION DATE DECEMBER 1, 2023.
40. EXISTING CONCRETE PAVEMENT (FUEL FARM)

SHEET NOTES:

1. PRIOR TO CONSTRUCTION, CONTRACTOR AND RPR SHALL VIDEOTAPE / PHOTOGRAPH ALL HAUL ROADS TO BE USED DURING THE PROJECT. THE INFORMATION SHALL BE PROVIDED TO THE OWNER PRIOR TO NOTICE TO PROCEED. ANY DAMAGE TO THE PAVEMENT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO REPAIR, PER RPR. ALL COSTS SHALL BE RESPONSIBILITY OF THE CONTRACTOR.
2. CONTRACTOR TO COORDINATE UTILITY WORK WITH AIRPORT. CONTRACTOR TO PROVIDE A MINIMUM TWO WEEK NOTICE FOR ANY UTILITY WORK THAT WILL INTERRUPT AIRPORT ACCESS TO AND FROM MAINTENANCE FACILITY.
3. THE CONTRACTOR SHALL GIVE WAY TO AIRPORT TRAFFIC AT ALL TIMES DURING THE PROJECT.
4. THE CONTRACTOR SHALL NOT LEAVE THE LIMITS OF WORK AREAS AND THE DESIGNATED HAUL ROUTES AS SHOWN ON THE CONTRACT DOCUMENTS UNLESS OTHERWISE AUTHORIZED BY AIRPORT PERSONNEL.
5. CONTRACTOR SHALL SHUTTLE EMPLOYEES FROM A SEPARATE AIRPORT OVERFLOW PARKING LOT (WELSH ROAD, 3.5 MILES AWAY) TO BE CONFIRMED BY THE OWNER IF ADDITIONAL PARKING REQUIRED. SEE GC100.
6. CONTRACTOR EMPLOYEES SHALL NOT BE ALLOWED TO PARK PERSONAL VEHICLES AT AIRPORT VIEWING AREAS AT ANY TIME.

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Fax: 734-206-7973
www.cscos.com

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MICHAEL D. HOLDWICK
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PROFESSIONAL ENGINEER

ISSUED FOR BID

NO.	REVISION	DATE

DRAWN: GCH | CHK'D: MDH
DESIGNED: RDM
APPRV'D: MDH
DATE: SEPTEMBER 18, 2023

PROJECT NUMBER: 2241.7462.00

GERALD R. FORD INTERNATIONAL AIRPORT
SRE BUILDING EXPANSION

CONSTRUCTION SAFETY PHASING PLAN - PHASE 1

DRAWING NUMBER: GC102

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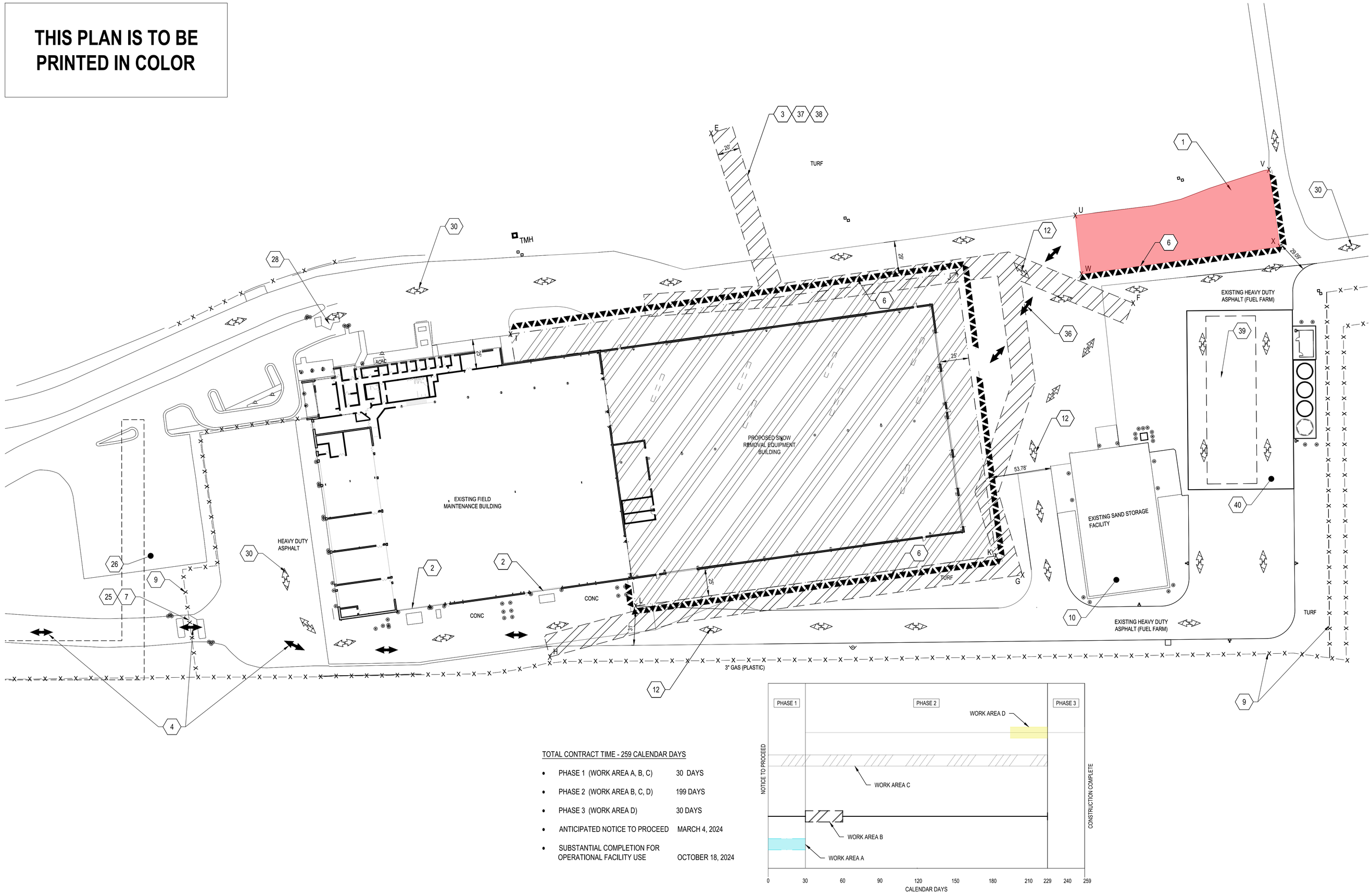

TOTAL CONTRACT TIME - 259 CALENDAR DAYS

- PHASE 1 (WORK AREA A, B, C) 30 DAYS
- PHASE 2 (WORK AREA B, C, D) 199 DAYS
- PHASE 3 (WORK AREA D) 30 DAYS
- ANTICIPATED NOTICE TO PROCEED MARCH 4, 2024
- SUBSTANTIAL COMPLETION FOR OPERATIONAL FACILITY USE OCTOBER 18, 2024

1 CONSTRUCTION SAFETY PHASING PLAN - PHASE 2

SCALE: 1" = 40'

NORTH

PHASE 2 (WORK AREA C) - 199 CALENDAR DAYS

PHASE 2 WILL INCLUDE CONSTRUCTION OF THE NEW SRE BUILDING

CONSTRUCTION:

- FULL DEPTH REMOVAL OF EXISTING PAVEMENT
- REMOVAL OF EXISTING ELECTRICAL CABLE AND CONDUIT
- REMOVAL OF EXISTING DRAINAGE
- REMOVAL OF EXISTING CONCRETE APRONS
- REMOVAL OF EXISTING BOLLARDS AND DOOR LOOPS
- REMOVAL OF EXISTING BUILDING DOORS
- CONSTRUCTION OF PROPOSED SRE BUILDING
- INSTALL AND CONNECT ROOF DRAINS

TRAFFIC IMPACTS:

- CONTRACTOR SHALL BARRICADE 25' OFFSET FROM EDGE OF BUILDING
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO SOUTH DOORS OF MAINTENANCE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO EXISTING SAND STORAGE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO NEW FUEL FACILITY AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS TO GATE 35 AT ALL TIMES.
- CONTRACTOR SHALL INSTALL NECESSARY STORM WATER PUMPS TO DRAIN LOW POINTS ON THE SITE

PHASE 2 (WORK AREA B)

THE SCOPE IN THIS AREA MUST BE COMPLETED CONCURRENT WITH PHASES 1 & 2 BASED ON THE LOCATION OF THE WORK. WORK AREA B WILL INCLUDE INSTALLATION OF NEW DRAINAGE SYSTEM FOR THE FINAL SITE.

CONSTRUCTION:

- INSTALL NEW DRAINAGE SYSTEM THROUGHOUT SITE.
- BACKFILL AND COMPACT DRAINAGE SYSTEM TO EXISTING GRADE TO RESTORE AIRPORT VEHICLE TRAFFIC

TRAFFIC IMPACTS:

- CONTRACTOR SHALL BACKFILL AND COMPACT TRENCH AS INSTALLATION PROGRESSES TO RESTORE AIRPORT VEHICULAR TRAFFIC
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO EXISTING MAINTENANCE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO EXISTING SAND STORAGE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO NEW FUEL FACILITY AT ALL TIMES
- CONTRACTOR SHALL BARRICADE ALL OPEN TRENCHES AT ALL TIMES

KEYED NOTES

1. CONTRACTOR STAGING AREA
2. SOUTH EXISTING MAINTENANCE FACILITY DOORS TO REMAIN OPERATIONAL AT ALL TIMES DURING CONSTRUCTION
3. CONTRACTOR TO COORDINATE UTILITY WORK WITH AIRPORT. CONTRACTOR TO PROVIDE A MINIMUM TWO WEEK NOTICE FOR ANY UTILITY WORK THAT WILL INTERUPT AIRPORT ACCESS TO AND FROM MAINTENANCE FACITLITY
4. CONTRACTOR VEHICLE ACCESS ROUTE TO PROJECT SITE. CONTRACTOR SHALL GIVE RIGHT OF WAY TO AIRPORT OPERATIONS VEHICLES AT ALL TIMES
6. TEMPORARY BARREL BARRICADES, SEE DETAIL 1/GC501
7. CONTRACTOR SHALL UTILIZE GATE 36 TO ACCESS SRE PROJECT
9. EXISTING FENCE
10. EXISTING SAND STORAGE BUILDING
12. AIRPORT OPERATIONS VEHICLE ROUTES DURING PHASE 2 CONSTRUCTION
25. PERSONAL VEHICLES CANNOT BE PARKED WITHIN LOCATION INSIDE THE SECURED AREA.
26. CONTRACTOR EMPLOYEE PARKING (UP-TO 10 SPACES ONLY). REFER TO CSPP. SEE NOTES 5 AND 6 THIS SHEET
28. CONTRACTOR SHALL ALLOW AIRPORT TRAFFIC ACCESS TO GATE 35 AT ALL TIMES
30. AIRPORT OPERATIONS VEHICLE ROUTES TO AIRFIELD
36. CONTRACTOR ACCESS BETWEEN STAGING AREA AND SRE BUILDING SITE. CONTRACTOR SHALL GIVE RIGHT OF WAY TO AIRPORT TRAFFIC AT ALL TIMES.
37. CONTRACTOR SHALL BACKFILL ALL TRENCHES TO EXISTING GRADE EACH DAY TO ALLOW AIRPORT TRAFFIC TO CROSS
38. CONTRACTOR SHALL PLACE BARRICADES AROUND ALL OPEN TRENCHES AND UNEVEN SURFACES AT ALL TIMES
39. FUEL FARM FACILITY (BY OTHERS). ANTICIPATED COMPLETION DATE DECEMBER 1, 2023.
40. EXISTING CONCRETE PAVEMENT (FUEL FARM)

SHEET NOTES:

1. PRIOR TO CONSTRUCTION, CONTRACTOR AND RPR SHALL VIDEOTAPE / PHOTOGRAPH ALL HAUL ROADS TO BE USED DURING THE PROJECT. THE INFORMATION SHALL BE PROVIDED TO THE OWNER PRIOR TO NOTICE TO PROCEED. ANY DAMAGE TO THE PAVEMENT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO REPAIR, PER RPR. ALL COSTS SHALL BE RESPONSIBILITY OF THE CONTRACTOR.
2. CONTRACTOR TO COORDINATE UTILITY WORK WITH AIRPORT. CONTRACTOR TO PROVIDE A MINIMUM TWO WEEK NOTICE FOR ANY UTILITY WORK THAT WILL INTERRUPT AIRPORT ACCESS TO AND FROM MAINTENANCE FACILITY.
3. THE CONTRACTOR SHALL GIVE WAY TO AIRPORT TRAFFIC AT ALL TIMES DURING THE PROJECT.
4. THE CONTRACTOR SHALL NOT LEAVE THE LIMITS OF WORK AND THE DESIGNATED HAUL ROUTES AS SHOWN ON THE CONTRACT DOCUMENTS UNLESS OTHERWISE AUTHORIZED BY AIRPORT PERSONNEL.
5. CONTRACTOR SHALL SHUTTLE EMPLOYEES FROM A SEPARATE AIRPORT OVERFLOW PARKING LOT (WELSH ROAD, 3.5 MILES AWAY) TO BE CONFIRMED BY THE OWNER IF ADDITIONAL PARKING REQUIRED. SEE GC100.

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PROFESSIONAL ENGINEER

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NO.	REVISION	DATE

DRAWN: GCH CHK'D: MDH
DESIGNED: RDM
APPRV'D: MDH
DATE: SEPTEMBER 18, 2023

PROJECT NUMBER 2241.7462.00

GERALD R. FORD INTERNATIONAL AIRPORT
SRE BUILDING EXPANSION

CONSTRUCTION SAFETY PHASING PLAN - PHASE 2

DRAWING NUMBER GC103

CIVIL

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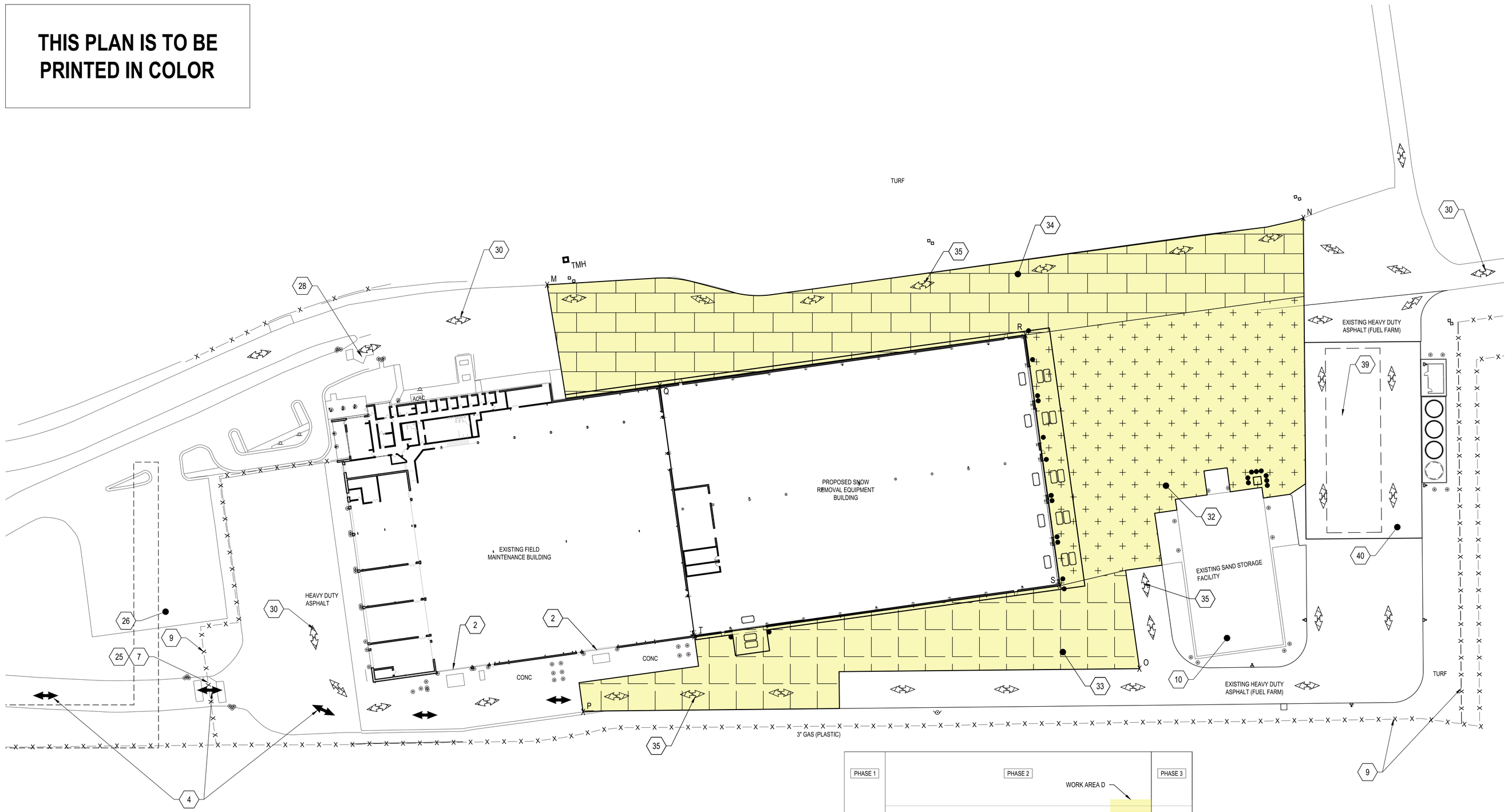
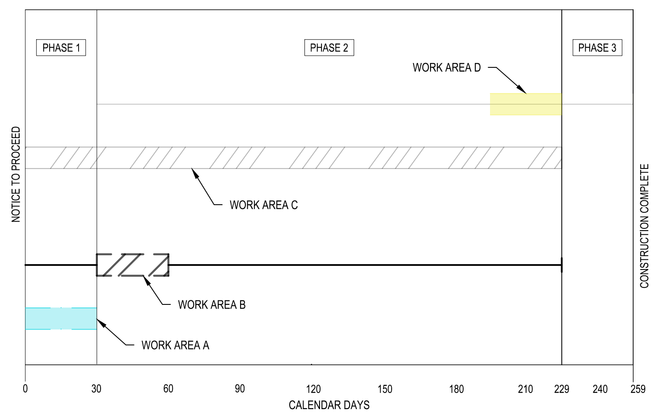


TOTAL CONTRACT TIME - 259 CALENDAR DAYS

- PHASE 1 (WORK AREA A, B, C) 30 DAYS
- PHASE 2 (WORK AREA B, C, D) 199 DAYS
- PHASE 3 (WORK AREA D) 30 DAYS
- ANTICIPATED NOTICE TO PROCEED MARCH 4, 2024
- SUBSTANTIAL COMPLETION FOR OPERATIONAL FACILITY USE OCTOBER 18, 2024



1 CONSTRUCTION SAFETY PHASING PLAN - PHASE 3

NORTH

SCALE: 1" = 40'

PHASE 3 (WORK AREA D) - 30 CALENDAR DAYS

PHASE 3 WILL INCLUDE DEMO AND FINAL PAVING OF THE SITE

CONSTRUCTION:

- DEMO OF ALL SITE PAVEMENT
- ADJUST PROPOSED STRUCTURES TO FINAL ELEVATION
- SALVAGE AND REGRADE EXISTING BASE COURSE
- SELECT FULL DEPTH PAVEMENT REMOVAL
- COMPACT ALL BASE COURSE
- PAVE NEW ASPHALT COURSE
- TIE PAVEMENTS INTO EXISTING BUILDINGS AND PAVEMENTS

TRAFFIC IMPACTS:

- CONTRACTOR SHALL BARRICADE 10' OFFSET OF EACH LOT PAVED AS CONSTRUCTION PROGRESSES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO SOUTH DOORS OF MAINTENANCE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO EXISTING SAND STORAGE BUILDING AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS LOOP TO NEW FUEL FACILITY AT ALL TIMES
- CONTRACTOR SHALL ENSURE AIRPORT VEHICLE FLEET ACCESS TO GATE 35 AT ALL TIMES.
- CONTRACTOR SHALL INSTALL NECESSARY STORM WATER PUMPS TO DRAIN LOW POINTS ON THE SITE

SUBPHASE 3.1: CONTRACTOR SHALL PAVE FIRST TO ALLOW AIRPORT VEHICLE ACCESS TO EAST DOORS OF FACILITY. CONTRACTOR SHALL NOT IMPACT AIRPORT TRAFFIC NORTH OR SOUTH OF THIS PHASE DURING THIS SUBPHASE. THIS WORK MUST BE COMPLETED PRIOR TO OCTOBER 18, 2023.

SUBPHASE 3.2: CONTRACTOR SHALL ALLOW ONE LANE OF AIRPORT VEHICLE TRAFFIC TO ACCESS SOUTH DOORS OF EXISTING FACILITY AT ALL TIMES.

SUBPHASE 3.3: CONTRACTOR SHALL ALLOW ONE LANE OF AIRPORT VEHICLE TRAFFIC TO ACCESS SOUTH DOORS OF EXISTING FACILITY AT ALL TIME.S.

KEYED NOTES

2. SOUTH EXISTING MAINTENANCE FACILITY DOORS TO REMAIN OPERATIONAL AT ALL TIMES DURING CONSTRUCTION
4. CONTRACTOR VEHICLE ACCESS ROUTE TO PROJECT SITE. CONTRACTOR SHALL GIVE RIGHT OF WAY TO AIRPORT OPERATIONS VEHICLES AT ALL TIMES
7. CONTRACTOR SHALL UTILIZE GATE 36 TO ACCESS SRE PROJECT
9. EXISTING FENCE
25. PERSONAL VEHICLES CANNOT BE PARKED WITHIN LOCATION INSIDE THE SECURED AREA.
26. CONTRACTOR EMPLOYEE PARKING (UP-TO 10 SPACES ONLY), REFER TO CSPP. SEE NOTES 5 AND 6 THIS SHEET
28. CONTRACTOR SHALL ALLOW AIRPORT TRAFFIC ACCESS TO GATE 35 AT ALL TIMES
30. AIRPORT OPERATIONS VEHICLE ROUTES TO AIRFIELD
32. CONTRACTOR SHALL MAINTAIN ONE-WAY TRAFFIC AT ALL TIMES DURING SUBPHASE 3.1
33. CONTRACTOR SHALL MAINTAIN ONE-WAY TRAFFIC AT ALL TIMES DURING SUBPHASE 3.2
34. CONTRACTOR SHALL MAINTAIN ONE-WAY TRAFFIC AT ALL TIMES DURING SUBPHASE 3.3
35. AIRPORT OPERATIONS VEHICLE ROUTES DURING PHASE 3 CONSTRUCTION
39. FUEL FARM FACILITY (BY OTHERS). ANTICIPATED COMPLETION DATE DECEMBER 1, 2023.
40. EXISTING CONCRETE PAVEMENT (FUEL FARM)

SHEET NOTES:

1. PRIOR TO CONSTRUCTION, CONTRACTOR AND RPR SHALL VIDEOTAPE / PHOTOGRAPH ALL HAUL ROADS TO BE USED DURING THE PROJECT. THE INFORMATION SHALL BE PROVIDED TO THE OWNER PRIOR TO NOTICE TO PROCEED. ANY DAMAGE TO THE PAVEMENT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO REPAIR, PER RPR. ALL COSTS SHALL BE RESPONSIBILITY OF THE CONTRACTOR.
2. CONTRACTOR TO COORDINATE UTILITY WORK WITH AIRPORT. CONTRACTOR TO PROVIDE A MINIMUM TWO WEEK NOTICE FOR ANY UTILITY WORK THAT WILL INTERRUPT AIRPORT ACCESS TO AND FROM MAINTENANCE FACILITY.
3. THE CONTRACTOR SHALL GIVE WAY TO AIRPORT TRAFFIC AT ALL TIMES DURING THE PROJECT.
4. THE CONTRACTOR SHALL NOT LEAVE THE LIMITS OF WORK AND THE DESIGNATED HAUL ROUTES AS SHOWN ON THE CONTRACT DOCUMENTS UNLESS OTHERWISE AUTHORIZED BY AIRPORT PERSONNEL.
5. CONTRACTOR SHALL SHUTTLE EMPLOYEES FROM A SEPARATE AIRPORT OVERFLOW PARKING LOT (WELSH ROAD, 3.5 MILES AWAY) TO BE CONFIRMED BY THE OWNER IF ADDITIONAL PARKING REQUIRED. SEE GC100.
6. CONTRACTOR EMPLOYEES SHALL NOT BE ALLOWED TO PARK PERSONAL VEHICLES AT AIRPORT VIEWING AREAS AT ANY TIME.
7. THE CONTRACTOR MAY CONTINUE TO WORK ON WORK AREA C (INTERIOR WORK ONLY) DURING THIS PHASE.

40 0 40 80FT.

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STATE OF MICHIGAN
MICHAEL D. HOLDWICK
ENGINEER
NO. 6201057577
PROFESSIONAL ENGINEER

ISSUED FOR BID

NO.	REVISION	DATE

DRAWN: GCH CHK'D: MDH
DESIGNED: RDM
APPRV'D: MDH
DATE: SEPTEMBER 18, 2023
PROJECT NUMBER 2241.7462.00

GERALD R. FORD INTERNATIONAL AIRPORT
SRE BUILDING EXPANSION

CONSTRUCTION SAFETY PHASING PLAN - PHASE 3

DRAWING NUMBER GC104

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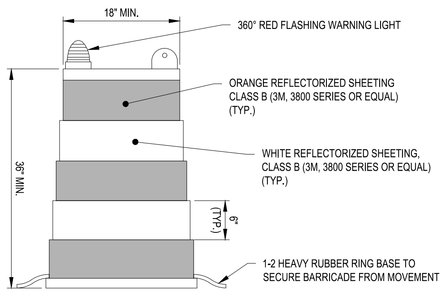
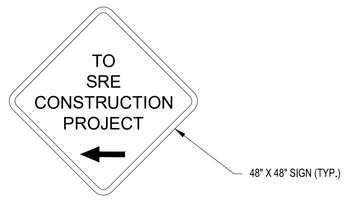


NOTE:

BARRICADES SHALL BE SPACED 8' MAX. O.C.

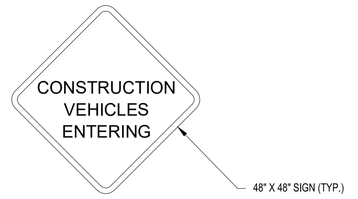
1 PLASTIC BARRICADE DETAIL
SCALE: NOT TO SCALE



SIGN NOTES:

1. SIGN BACKGROUND IS TO BE ORANGE. SIGN LETTERING IS TO BE BLACK, MINIMUM HEIGHT OF 3", AND BE A BOLD LETTERING STYLE SIMILAR TO DETAIL SHOWN ON THIS SHEET.
2. SIGN SHALL BE LOCATED HIGH ENOUGH TO ALLOW EASY VIEWING FROM ALL CONSTRUCTION VEHICLES ENTERING THE CONSTRUCTION SITE.
3. SEE PHASING DRAWINGS FOR GENERAL LOCATIONS. THE CONTRACTOR SHALL COORDINATE THE EXACT PLACEMENT AND LOCATION OF ALL CONSTRUCTION TRAFFIC SIGNS WITH THE AIRPORT AND ENGINEER.
4. SEE DETAIL 7 THIS SHEET FOR SIGN MOUNTING/ASSEMBLY.

6 CONSTRUCTION PROJECT LOCATION SIGN DETAIL
SCALE: NOT TO SCALE



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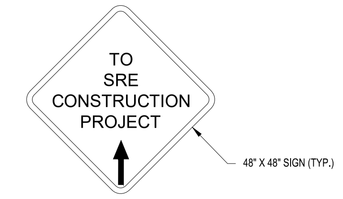
3 CONSTRUCTION VEHICLES ENTERING SIGN
SCALE: NOT TO SCALE

7 CONSTRUCTION SIGN ASSEMBLY DETAIL
SCALE: NOT TO SCALE



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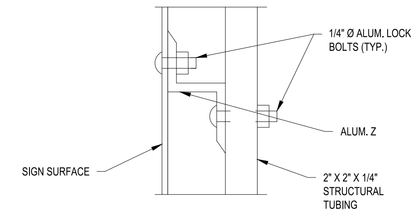
4 CONSTRUCTION PROJECT LOCATION SIGN DETAIL
SCALE: NOT TO SCALE

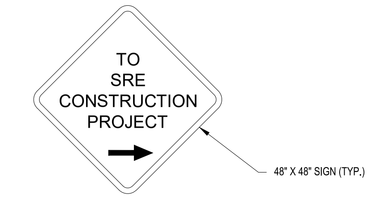


MOUNTING DETAIL

SIGN NOTES:

1. ALL SIGNS SHALL CONFORM IN SIZE, APPEARANCE AND REFLECTORIZATION TO THE REQUIREMENTS OF THE MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MMUTCD).
2. AT PROJECT COMPLETION, ALL POSTS AND SIGNS SHALL BE REMOVED FROM AIRPORT PROPERTY AND SHALL REMAIN PROPERTY OF THE CONTRACTOR.
3. CONTRACTOR TO VERIFY PRESENCE OF EXISTING FOUNDATIONS AND TUBING PRIOR TO PURCHASE & INSTALLATION OF TEMPORARY CONSTRUCTION SIGNS. EXISTING FOUNDATIONS MAY BE UTILIZED PROVIDED THEY ARE IN THE CORRECT LOCATIONS.

5 CONSTRUCTION PROJECT LOCATION SIGN DETAIL
SCALE: NOT TO SCALE



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Fax: 734-206-7973
www.cscos.com

STATE OF MICHIGAN
MICHAEL D. HOLDWICK
ENGINEER
NO. 6201057577
PROFESSIONAL ENGINEER

ISSUED FOR BID

DRAWN: GCH	CHK'D: MDH
DESIGNED: RDM	
APPRV'D: MDH	
DATE: SEPTEMBER 18, 2023	
PROJECT NUMBER	2241.7462.00

NO.	REVISION	DATE

DRAWING NUMBER: GC501

GERALD R. FORD INTERNATIONAL AIRPORT
SRE BUILDING EXPANSION

CONSTRUCTION SAFETY PHASING DETAILS

CIVIL

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APPENDIX 2

CONSTRUCTION PROJECT DAILY SAFETY INSPECTION CHECKLIST

Construction Project Daily Safety Inspection Checklist

The situations identified below are potentially hazardous conditions that may occur during airport construction projects. Safety Area encroachments, unauthorized and improper ground vehicle operations, and unmarked or uncovers holes and trenches near aircraft operating surfaces pose the most prevalent threats to airport operational safety during airport construction projects. The list below is one tool that the Contractor may use to aid in identifying and correcting potentially hazardous conditions.

Potentially Hazardous Conditions

Item	Action Required	or	None
Excavation adjacent to runways, taxiways, and aprons improperly backfilled.			☐
Mounds of earth, construction materials, temporary structures, and other obstacles near any open runway, taxiway, or taxi lane; in the related Object Free area and aircraft approach or departure areas/zones; or obstructing any sign or marking.			☐
Runway resurfacing projects resulting in lips exceeding 3 inches from pavement edges and ends.			☐
Heavy equipment (stationary or mobile) operating or idle near AOA, in runway approaches and departures areas, or in OFZ.			☐
Equipment or material near NAVAIDs that may degrade or impair radiated signals and/or the monitoring of navigation and visual aids. Unauthorized or improper vehicle operations in localizer or glide slope critical areas, resulting in electronic interference and/or facility shutdown.			☐
Tall and especially relatively low visibility units (that is, equipment with slim profiles) –cranes, drills, and similar objects—located in critical areas, such as OFZ and approach zones.			☐
Improperly positioned or malfunctioning lights or unlighted airport hazards, such as holes or excavations, on an apron, open taxiway, or open taxi lane or in related safety, approach, or departure area.			☐

Item	Action Required	or	None
Obstacles, loose pavement, trash, and other debris on or near AOA. Construction debris (gravel, sand, mud, paving materials) on airport pavements may result in aircraft propeller, turbine engine, or tire damage. Also, loose materials may blow about, potentially causing personal injury or equipment damage.			☐
Inappropriate or poorly maintained fencing during construction intended to deter human and animal intrusions into the AOA. Fencing and other markings that are inadequate to separate construction areas from open AOA create aviation hazards.			☐
Improper or inadequate marking or lighting of runways (especially thresholds that have been displaced or runways that have been closed) and taxiways that could cause pilot confusion and provide a potential for a runway incursion. Inadequate or improper methods of marking, barricading, and lighting of temporarily closed portions of AOA create aviation hazards.			☐
Wildlife attractants — such as trash (food scraps not collected from construction personnel activity), grass seeds, tall grass, or standing water — on or near airports.			
Obliterated or faded temporary markings on active operational areas.			☐
Misleading or malfunctioning obstruction lights. Unlighted or unmarked obstructions in the approach to any open runway pose aviation hazards.			☐
Failure to issue, update, or cancel NOTAMs about airport or runway closures or other construction related airport conditions.			☐
Failure to mark and identify utilities or power cables. Damage to utilities and power cables during construction activity can result in the loss of runway / taxiway lighting; loss of navigation, visual, or approach aids; disruption of weather reporting services; and/or loss of communications.			☐
Restrictions on ARFF access from fire stations to the runway / taxiway system or airport buildings.			

Item	Action Required	or	None
Lack of radio communications with construction vehicles in airport movement areas.			☐
Objects, regardless of whether they are marked or flagged, or activities anywhere on or near an airport that could be distracting, confusing, or alarming to pilots during aircraft operations.			☐
Water, snow, dirt, debris, or other contaminants that temporarily obscure or derogate the visibility of runway/taxiway marking, lighting, and pavement edges. Any condition or factor that obscures or diminishes the visibility of areas under construction.			☐
Spillage from vehicles (gasoline, diesel fuel, oil) on active pavement areas, such as runways, taxiways, aprons, and airport roadways.			☐
Failure to maintain drainage system integrity during construction (for example, no temporary drainage provided when working on a drainage system).			
Failure to provide for proper electrical lockout and tagging procedures. At larger airports with multiple maintenance shifts/workers, construction contractors should make provisions for coordinating work on circuits.			☐
Failure to control dust. Consider limiting the amount of area from which the Contractor is allowed to strip turf.			☐
Exposed wiring that creates an electrocution or fire ignition hazard. Identify and secure wiring, and place it in conduit or bury it.			☐
Site burning, which can cause possible obscuration.			☐
Construction work taking place outside of designated work areas and out of phase.			☐

APPENDIX 3

CONTRACTORS SAFETY PLAN COMPLIANCE DOCUMENT (SPCD)

(The SPCD Certification is located in the Proposal Section)

SAFETY PLAN COMPLIANCE DOCUMENT (SPCD)

Project Location: Gerald R. Ford International Airport

Project Name: SRE Building Expansion

General Statement:

The Construction Safety and Phasing Plan (CSPP), identified as Attachment "A" to Section 70-08, has been prepared in accordance with FAA Advisory Circular 150/5370-2G, *Operational Safety on Airports During Construction and the requirements of the Airport Owner*. The CSPP has been submitted to the FAA for review and comment. Any comments from the FAA which were received prior to bid opening have been incorporated into the CSPP.

In the event that the FAA transmits comments which require that the CSPP be revised after bid opening, I understand that I am obligated to abide by the conditions and statements contained in the revised CSPP. I further understand that I will be given the opportunity to evaluate the revised CSPP as it relates to my contract and request appropriate compensation in accordance with the provisions of the contract.

Supplemental Information:

Where the CSPP covers a subject and no additional information is needed, the statement below reads, "No supplemental information required". Where additional information is required by the Contractor, the information shall be provided in the spaces below.

The section numbers below correspond with the section numbers in the CSPP.

3.1 Coordination

Statement: [Explain how you will distribute information and details of meetings to employees and subcontractors.]

_____

_____

_____

_____

3.2 Phasing

Statement: [List the number of days each Work Area will take. State the time day work will start and finish for each work area.]

_____

_____

_____

_____

3.3 Areas and operations affected by the construction activity

Statement: Information is provided in the CSPP. No supplemental information is required.

3.4 Protection of NAVAIDs

Statement: Information is provided in the CSPP. No supplemental information is required.

3.5 Contractor Access

Security Statement: [Explain how you will maintain integrity of the airport security fence at the access gate, e.g.: Gate guards, closed and locked gates, temporary fencing, etc.]

Training Statement: [List individuals who will receive driver training (for certificated airports and as requested.]

Communication Statement: [Identify types of radios, if any, you will use to communicate with drivers and personnel. Identify who will be monitoring radios. Identify a contact person and phone number if ATCT cannot reach the contractor's designated person by radio.]

Escort Statement: [Identify who will escort material delivery vehicles.]

3.6 Wildlife Management

Statement: [Identify who will be monitoring wildlife in the construction area. Identify who will be monitoring wildlife at the construction gate.]

3.7 Foreign Object Debris (FOD) Management

Statement: [Identify who will be preparing a FOD Management Plan. (Plan must be approved prior to the start of construction activities.)]

3.8 Hazardous material (HAZMAT) management

Statement: [Identify who will be preparing a Spill Prevention Plan. (Plan must be approved prior to the start of construction activities.)]

3.9 Notification of construction activities. Provide the following:

Key Personnel Statement: [Identify your key personnel points of contact with phone numbers.]

Emergency Contacts Statement: [Identify your emergency contacts with 24 hour phone numbers.]

Equipment Statement: [Part 77: Identify equipment you will be using that is taller than feet, including on-site batch plants. Identify the maximum height it will be extended to during construction for each Work Area and the expected duration. Identify when during the day it will be used.]

3.10 Inspection requirements.

Statement: [Identify the person who will be responsible for daily inspections to ensure conformance with the CSPP. Describe additional inspections you will employ, if any, to ensure conformance.]

3.11 Underground utilities.

Statement: [Discuss proposed methods of identifying and protecting underground utilities.]

3.12 Penalties

Statement: Information is provided in the CSPP. No supplemental information is required.

3.13 Special conditions.

Statement: [Identify who will be responsible for moving equipment and personnel from the work area and vacating the area in the event of a special condition listed in the CSPP.]

3.14 Runway and taxiway visual aids. Including marking, lighting, signs, and visual NAVAIDs.

Statement: Information is provided in the CSPP. No supplemental information is required.

3.15 Marking and signs for access routes. Discuss proposed methods of demarcating access routes for vehicle drivers.

Statement: Information is provided in the CSPP. No supplemental information is required.

3.16 Hazard marking and lighting.

Statement: [Identify who will be responsible for maintaining hazard marking and lighting. Include a 24 hour phone number.]

3.17 Protection of taxiway and runway safety areas. Include object free areas, obstacle free zones, approach/departure surfaces and safety areas as required. Discuss proposed methods of identifying, demarcating, and protecting airport surfaces including:

Equipment and methods for maintaining Taxiway/Taxilane Safety Area standards.

Statement: Information is provided in the CSPP. No supplemental information is required.

Equipment and methods for separation of construction operations from aircraft operations, including details of barricades.

Statement: Information is provided in the CSPP. No supplemental information is required.

3.18 Other limitations on construction.

Other limitations are identified in the CSPP and do not require an entry in this document.

APPENDIX 4

SPOIL DEPOSITION RELEASE FORM

SPOILS DEPOSITION RELEASE FORM

To: Gerald R. Ford International Airport Authority (AIRPORT OWNER), and

C&S Engineers, Inc., (RPR).

Project: SRE Building Expansion

This SPOILS DEPOSITION RELEASE FORM is being forwarded to the above referenced AIRPORT OWNER and RPR to satisfy the Contract Documents governing the above referenced project. Pursuant to the Contract Documents, LANDOWNER has granted permission to CONTRACTOR to deposit spoils at LANDOWNER'S property located at _____ (give specific location). Further, CONTRACTOR hereby agrees to the greatest extent of the law, to release, indemnify, hold harmless, and defend the AIRPORT OWNER and RPR from any and all damage, liability, or cost (including reasonable attorney's fees and cost of defense) to the extent caused by or arising out of the deposition of the spoils on LANDOWNER'S property.

CONTRACTOR:	**LANDOWNER:**
_____	_____
Signature	Signature
_____	_____
Written Name & Title	Written Name & Title
_____	_____
Company Name	Company Name
_____	_____
Mailing Address (Street Name and Number)	Mailing Address (Street Name and Number)
_____	_____
City, State, Zip Code	City, State, Zip Code
_____	_____
Daytime Phone Number (Include Area Code)	Daytime Phone Number (Include Area Code)
_____	_____
Date	Date

APPENDIX 5

SAFETY PLAN COMPLIANCE DOCUMENT (SPCD) CERTIFICATION

SAFETY PLAN COMPLIANCE DOCUMENT (SPCD) CERTIFICATION

Project Location: _____

Project Name: _____

Contractor's Official Name: _____

Contact Person: _____ Telephone: _____

Street Address: _____

City:_____State:_____Zip: _____

Certification Statement:

I certify that I have read the Construction Safety and Phasing Plan (CSPP) included in the Contract Documents and if awarded this Contract, I will abide by its requirements as written.

I certify that I have read the Safety Plan Compliance Document (SCPD) included in the Contract Documents and if awarded this Contract, I will abide by its requirements as written;

I certify that I will provide the information required in the SCPD prior to the start of construction work, if awarded this Contract, and that I will provide any additional information requested by the Airport Owner.

_____	_____
Printed Name of Signer	Signature
_____	_____
Title	Date

Section 80 Execution and Progress

80-01 Subletting of contract. The Owner will not recognize any subcontractor on the work. The Contractor shall at all times when work is in progress be represented either in person, by a qualified superintendent, or by other designated, qualified representative who is duly authorized to receive and execute orders of the Resident Project Representative (RPR).

The Contractor shall perform, with his organization, an amount of work equal to at least 25 percent of the total contract cost.

Should the Contractor elect to assign their contract, said assignment shall be concurred in by the surety, shall be presented for the consideration and approval of the Owner, and shall be consummated only on the written approval of the Owner.

The Contractor shall provide copies of all subcontracts to the RPR 14 **days prior to being utilized on the project. As a minimum, the information shall include the following:**

- Subcontractor's legal company name.
- Subcontractor's legal company address, including County name.
- Principal contact person's name, telephone and fax number.
- Complete narrative description, and dollar value of the work to be performed by the subcontractor.
- Copies of required insurance certificates in accordance with the specifications.
- Minority/ non-minority status.

80-02 Notice to proceed (NTP). The Owners notice to proceed will state the date on which contract time commences. The Contractor is expected to commence project operations within one day of the NTP date. The Contractor shall notify the RPR at least 24 hours in advance of the time contract operations begins. The Contractor shall not commence any actual operations prior to the date on which the notice to proceed is issued by the Owner.

80-03 Execution and progress. Unless otherwise specified, the Contractor shall submit their coordinated construction schedule showing all work activities for the RPR's review and acceptance at least 10 days prior to the start of work. The Contractor's progress schedule, once accepted by the RPR, will represent the Contractor's baseline plan to accomplish the project in accordance with the terms and conditions of the Contract. The RPR will compare actual Contractor progress against the baseline schedule to determine that status of the Contractor's performance. The Contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the plans and specifications within the time set forth in the proposal.

If the Contractor falls significantly behind the submitted schedule, the Contractor shall, upon the RPR's request, submit a revised schedule for completion of the work within the contract time and modify their operations to provide such additional materials, equipment, and labor necessary to meet the revised

schedule. Should the execution of the work be discontinued for any reason, the Contractor shall notify the RPR at least 24 hours in advance of resuming operations.

The Contractor shall not commence any actual construction prior to the date on which the NTP is issued by the Owner.

The project schedule shall be prepared as a network diagram in Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), or other format, or as otherwise specified. It shall include information on the sequence of work activities, milestone dates, and activity duration. The schedule shall show all work items identified in the project proposal for each work area and shall include the project start date and end date.

80-03.1 Requirements.

A. Nomenclature and Definitions

B. Schedule Personnel

C. Software Compatibility Requirements

D. Preconstruction Schedule Meeting

E. Baseline Schedule Development

F. Progress Schedule Update

G. Schedule for Submittals

80-03.1.A Nomenclature and Definitions

Actual Start date- At the task level, the Actual Start date represents the point in time that meaningful work actually started on a task.

Actual Finish date - At the task level, the Actual Finish date represents the point in time that work actually ended on a task.; At the Project level, the Actual Finish date represents the point in time that the Contractor completes all Work in accordance with the time standards described in the CSPP.

Baseline Progress Schedule - The Progress Schedule submitted by the Contractor and accepted by the RPR that shows the plan to complete the construction contract work. The Baseline Schedule represents the Contractor's plan at the time of Contract Award for completing the Project.

Bid Date – The date that bids will be publicly opened and read aloud.

Constraint - A schedule restriction imposed on the Start or Finish date(s) of a task that modifies or overrides a task's relationships.

Critical Task – A task on the critical path.

Critical Path – In the Progress Schedule, the critical path shall be those tasks being on the longest path. In a project network diagram, the series of tasks determines the earliest completion of the project.

Critical Delay - An event, action, or other factor that delays the critical path of the Progress Schedule and extends the time needed for completion of the construction project.

Critical Path Method (CPM) – A network analysis technique used to predict Project duration by analyzing which sequence of tasks (which path) has the least amount of scheduling flexibility (the least amount of float or slack). A scheduling technique utilizing tasks, durations, and interrelationships/dependencies (logic), such that all tasks are interrelated with logic ties from the

beginning of the project to the completion of the project. Early dates are calculated by means of a forward pass using a specified start date. Late dates are calculated by means of a backward pass starting from a specified completion date (usually the forward pass's calculated project early finish date).

Duration, Original - The original estimated number of Working Days (not including holidays or other nonworking periods) in which the work task associated with the task is expected to be performed. (The number of calendar days may be different based on the calendar assigned to the task.) For certain tasks such as concrete curing, or others approved by the RPR, the calendar shall reflect no non-working days.

Duration, Remaining - The estimated time, expressed in Working Days (not including holidays or other nonworking periods), needed to complete a task that has started but has not finished

Early Dates – The earliest date a task can start or finish based upon logic and durations. They are calculated by the software application when scheduling the project. Progress Schedules.

Final Baseline Progress Schedule @ Award - The original plan against which the Contractor's progress is measured. The Final Baseline Progress Schedule @ Award represents the original plan at the award of the Contract, of what is expected to happen. Once the Final Baseline Progress Schedule @ Award is accepted by the RPR it is saved and used as a basis to compare against Progress Schedules Updates. (See also Section 80-3 of the FAA's General Provisions.)

Fragnet – A subdivision of a project network diagram usually representing some portion of the project.

Late Dates – The latest a task can start or finish without delaying the time standards contained in the CSPP.

Longest Path - The sequence of tasks through the Progress Schedule network that establishes the Milestones contained in the CSPP.

Look-Ahead Schedule – Commonly a one or two week time segment generated from the accepted Progress Schedule that forecasts the work planned for the one or two week period following the Status Date, and includes any major materials to be delivered anticipated shifts in Work Areas.

Milestone – A task with zero duration that typically represents a significant event, usually the beginning and end of the project, milestones set forth in the contract proposal, construction stages, a major work package, or the contract interim time-related clauses.

Notice to Proceed– The actual date the Contractor starts fieldwork of a contract pay item, which is entered as a Start milestone task in the schedule. Contractually no work may start until after the Contract is awarded by the Owner, and the Contractor has received a written Notice to Proceed.

Open End - The condition that exists when a task has either no predecessor or no successor, or when a task's only predecessor relationship is a finish-to-finish relationship or only successor relationship is a start-to-start relationship.

Predecessor – A task that is defined by Schedule logic to precede another task. A predecessor may control the Start Date or Finish Date of its successor.

Progress Schedule –Also referred to as the Project's Schedule.

Progress Schedule Update – Changes to the Progress Schedule that reflect the status of tasks that have commenced or have been completed, including the following items: (a) Actual Start date and or

Actual Finish date as appropriate; (b) Remaining Duration for tasks commenced and not complete; and (c) Suspend or Resume dates for tasks commenced and not complete.

Progress Schedule Revision – Revisions to the Progress Schedule ensures it accurately reflects the current means and methods of how the Project is anticipated to progress, including modifications made to any of the following items: (a) changes in logic connections between tasks; (b) changes in constraints; (c) changes to task descriptions; (d) task additions or deletions; (e) changes in calendar assignments.

Project Scheduler – The person that is responsible for developing and maintaining the Progress Schedule.

Recovery Schedule – A schedule depicting the plan for recovery of significant time lost on the project. This separate CPM schedule submission shall provide the resolution and include appropriate changes in network logic, task and calendar adjustments.

Relationships - The interdependence among tasks relationships link a task to its predecessors and successors. Relationships are defined as:

- **Finish to Start -** The successor task can start only when the current task finishes.
- **Finish to Finish –** The finish of the successor task depends on the finish of the current task.
- **Start to Start –** The start of the successor task depends on the start of the current task.
- **Start to Finish –** The successor task cannot finish until the current task starts.

Slack (Float), Free - The amount a task can slip without delaying the immediate successor task. Free Float is the property of a task and not the network path. The Owner owns the Project's Free Slack (Float).

Slack (Float) Suppression - Utilization of zero free slack (float) constraints which allows a task to start as late as possible by using all of its' available free slack (float). This technique allows tasks to appear more critical than if the task's total float was based on early dates. Assigning zero free float prevents true sharing of total float between the Owner and the Contractor. Utilization of overly generous task durations and overly restrictive calendar non-working periods are also considered to cause slack (float) suppression.

Slack (Float), Total - The amount of time a task (or chain of tasks) can be delayed from its early start without delaying the contract completion date. Float is a mathematical calculation and can change as the project progresses and changes are made to the project plan. Total Slack (Float) is calculated and reported for each task in a network, however, Total Float is an attribute of a network path and not associated with any one specific task along that path. The Owner owns the Project's Total Slack (Float).

Status Date – The date used to update a project. The Status Date is used as the starting point to calculate the schedule.

Task- A discrete, identifiable task or event that usually has an expected duration, has a definable Start Date and/or Finish Date, and can be used to plan, schedule, and monitor a project.

Work Breakdown Structure (WBS) - A deliverable-oriented grouping of project elements, which organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of project components or work packages.

Work Package - A deliverable that is a group of related tasks within a project at the lowest level of the work breakdown structure.

Work Day - A calendar day scheduled for active prosecution of contract work by the Contractor or the Contractor's representative. (See Section 10-65 of the FAA's General Provisions.)

80-03.1.B Scheduling Personnel. The Contractor shall designate a Project scheduler to have all scheduling responsibilities for the Work. The Project scheduler must have had previous scheduling responsibilities on similar projects of similar size and complexities.

80-03-1.C Software Compatibility Requirements. The Owner uses Microsoft Project 2019 to schedule and monitor its construction program. All schedules submitted shall be in a format compatible with this program and version.

80-03.1.D Preconstruction Schedule Coordination. The Contractor shall contact the RPR after notification they are the low bidder, but no later than two (2) Work Days following Contract award to coordinate schedule development. The purpose of this will be to discuss essential matters pertaining to the satisfactory scheduling of project tasks, and to resolve any known questions regarding interpretation of the contract requirements for this work. The Project Scheduler shall be prepared to discuss the following:

- The proposed hierarchal Work Breakdown Structure (WBS) for the Progress Schedules.
- The proposed Project calendars.
- The factors that the Contractor determines to control the completion of the project and any milestone task completion dates contained therein.
- File naming Procedures for submissions.

80-03.1.E Baseline Schedule Development. The Contractor shall prepare, furnish, and maintain a computer-generated Progress Schedule using the Critical Path Method on Microsoft Project scheduling software The Contractor and the Owner shall use the Progress Schedule to manage the Work. No Work other than installation of the Engineer's Field Office, mobilization, procurement and administrative tasks, will be permitted to start until the RPR in writing has approved the Baseline Progress Schedule.

The purpose of the Progress Schedule, and scheduling provisions in the Contract, shall be to:

- Ensure that the Contractor and the Owner have a detailed plan to complete the Project in accordance with time standards contained in the CSPP;
- Provide a means of monitoring the progress of Work;
- Aid in communication and coordination of tasks among all affected parties;
- Analyze the effect of changed conditions on the time standards contained in the CSPP;
- Analyze the impact of proposed Contract Amendments.
- Establish a standard methodology for time adjustment analysis based on the principles of the Critical Path Method of scheduling, to analyze delays and resolve construction disputes concerning time;
- Determine appropriate extensions or reductions of Contract Time.

In scheduling and executing the work, the Contractor shall:

- Sequence the Work to commensurate with the Contractor's abilities, resources and the Contract Documents. The scheduling of tasks is the responsibility of the Contractor.

- Ensure that Progress Schedules prepared by the Project Scheduler for submission to the Owner are in compliance with the Contract. The intent should be that Schedule submissions are timely, complete, accurate, and in compliance with the Contract.
- Communicate all Contract changes, and decisions or actions taken by the Contractor and all subcontractors, fabricators, etc., that effect the Progress Schedule to the Project Scheduler in a timely manner to allow appropriate development, maintenance, and update of the Progress Schedule.
- Include all Work contained in the Contract and all Work directed in writing by the RPR. Work tasks directed by the RPR to be added to the Contract shall be included in the next Monthly Progress Schedule submission.
- Assure that Progress Schedule Updates reflect the actual dates that work tasks started and were completed in the field.
- Break a schedule task into multiple tasks to reflect a discontinuity in the work if a work task is suspended in the field and restarted at a later date, and the break between when the Work was suspended to when it was resumed is significant compared to the original task duration.
- Ensure the Progress Schedule contains all Work constraints and Milestones defined in the Contract including the CSPP.
- Schedule the Work using such procedures and staging or phasing as required by the Contract. Work designated as part of separate stages may be performed concurrently with other stages where allowed by the Contract or where approved by the RPR. Failure by the Contractor to include any element of Work required by the Contract in the accepted Progress Schedule does not relieve the Contractor from its responsibility to perform such Work.

The schedule shall be developed utilizing the following elements:

- **Work Breakdown Structure (WBS)** - A multi-level hierarchal WBS shall be incorporated that provides a deliverable-oriented grouping of tasks and defines the total scope of the project. The Contractor shall develop a detailed project specific WBS for the RPR's review and approval prior to the development of the Baseline Schedule. The RPR shall make the final determination on the number of levels of the WBS, and how the tasks shall be grouped to represent the deliverables of the project. A minimum WBS shall consist of the following Levels (X)
    - PRECONSTRUCTION (1)
        - GENERAL(2)
        - SHOP DRAWING AND SUBMITTALS (2)
        - PROCUREMENT/FABRICATION/DELIVERY(2)
    - CONSTRUCTION (1)
        - WORK PHASE (2)
            - CONSTRUCTION COMPONENT (3) (earthwork, drainage, paving, etc.)
    - POST CONSTRUCTION(1)
        - PUNCHLIST (2)
        - DEMOBILIZATION (2)
        - PROJECT DOCUMENTATION (2)

- **Task ID** - Include a unique identification number for each task. Task ID numbers shall not be changed, or reassigned for the duration of the contract.
- **Task** - Clearly and uniquely define each task with a description of the work that is readily identifiable to inspection staff and the progress of each task can be measured.
- **Milestone Tasks** – To the extent not specifically addressed in the CSPP, this term include tasks for all Contract milestones that define significant contractual events such as Contract Award, Notice to Proceed, Contractor Start Work, Substantial Completion, Contract Completion, and coordination points with outside entities such as utilities, the FAA, Time-Related Contract Provisions, etc.
- **Task Durations** – Define the Original Duration of each task in units of whole work days. With the exception of submittal/procurement tasks, durations shall not exceed 15 work days unless approved by the RPR. Durations for RPR submittal reviews shall meet the requirements set forth in the contract documents. If requested by the RPR, the Contractor shall justify the reasonableness of planned task time durations.
- **Relationships** - Clearly assign predecessors and successors relationships to each task, and assign appropriate logic ties between tasks (Finish to Start, Start to Start, Finish to Finish, etc.). Open-ended tasks are not permitted, with the exception of the first and last tasks in the schedule. Do not include inappropriate logic ties with Milestone Tasks (For a finish milestone task: a predecessor shall only be assigned a Finish to Finish logic tie, a successor shall only be assigned a Finish to Start or Finish to Finish logic tie. For a start milestone: a predecessor shall only be assigned a Finish to Start or Start to Start logic tie, a successor shall only be assigned with a Start to Start logic tie). Lag time may not exceed 10 days. The Contractor shall assign the "Contract Award Date" task as a predecessor to all Review and Approval type tasks to be performed by the RPR.
- **Task Constraint Dates** – The Contractor shall not have any constrained tasks, with the exception of contractual dates, unless the RPR accepts such constraints in writing.
- **Task Dates** – With the exception of contract Milestone dates, "Actual Start" and "Actual Finish" dates and "Start" and "Finish" dates, task dates shall be calculated by the Project scheduler tool within the scheduling software.
- **Calendars** – Notwithstanding the Contractor's assigned risk for delays due to weather (See Section Nos. 80-6 and 80-7 of the FAA's General Provisions), use clearly defined calendars that account for expected seasonal weather conditions (including winter shutdown periods) and environmental permit requirements, for the planning and scheduling of tasks. Do not incorporate a task with a description of "Winter Shutdown" that requires constraints rather utilize non-working periods utilizing a Base Calendar.

80-03-1.F Progress Schedule Update

In addition to the detailed schedule requirements for the submission of the Baseline Progress Schedule, the Contractor shall complete the following additional requirements for Monthly Progress Schedule submissions:

Durations – The Original Duration shall not be changed without prior written justification by the Contractor, and written approval by the RPR. The Contractor shall edit the Remaining Duration to reflect progress made on work tasks, and shall not use Duration percentage. If a proposed change to Original Duration is due to additional or changed work to the Contract, the Contractor shall instead add a task to reflect this additional work. The Contractor shall not use zero durations for Task Dependent tasks.

Started and Finished dates – For each task where work was begun during the Monthly reporting period, the Contractor shall check the box adjacent to Started and enter the date the work began. For each task where work was completed during the Monthly reporting period.

If the Contractor fails to submit the required Progress Schedule updates and revisions, the Contractor waives its rights to adjustments of time and related compensation for delays that accrue during the period in which the progress schedule has not been submitted in accordance with the detailed CPM scheduling requirements.

The Owner will have no liability for any subsequent Contractor time related disputes which occurred during the period of time in which the Contractor failed to submit monthly progress schedule updates and revisions in a timely manner.

80-03.1.G Schedule for Submittals.

Progress Schedule submissions will only be considered complete when all documents and data have been provided to the RPR. When preparing a formal submission of the Progress Schedule, the Contractor shall make a pdf of the current Progress Schedule and name it according to the file naming convention determined at the Preconstruction Scheduling Meeting.

A. Submittals shall be uploaded to a designated location on the Project FTP Site as directed by the RPR with sufficient time to allow for review.

B. Allow five (5) calendar days for review and turnaround of Progress Schedule submittals.

C. Monthly submission of updated Progress Schedule shall be completed prior to processing of monthly pay requisition.

D. Immediate Rejection of Progress Schedule submissions**.** The following deficiencies in a Contractor's Progress Schedule submission shall be grounds for the immediate rejection by the RPR, without further review, analysis and/or comments.

- Failure of the Project Scheduler to "schedule" the Project, as of the status date.
- Any tasks without predecessors or tasks without successors, appearing in the Schedule with the exception of the first and last task in the schedule.
- Any task constraints appearing in the Schedule that have not been approved in writing by the RPR, or that are not specifically allowed by this specification.
- Any Tasks with Actual Dates > Status Date
- Any Milestone Tasks with invalid relationships
- Failure to have a clearly defined Critical Path from the Status Date to the last task in the schedule, using the Longest Path method. This would reflect logic errors in the project schedule.
- If any of these deficiencies are found, the Contractor's submission shall be considered deficient, and RPR will notify the Contractor immediately.

No direct payment will be made for the coordinated construction schedule. The cost of creating, revising, maintaining, updating, etc. the coordinated construction schedule shall be included in the price of the bid for the various items of the Contract.

The Contractor shall maintain the work schedule and provide an update and analysis of the progress schedule on a monthly basis, or as otherwise specified in the contract. Submission of the work schedule

shall not relieve the Contractor of overall responsibility for scheduling, sequencing, and coordinating all work to comply with the requirements of the contract.

80-04 Limitation of operations. The Contractor shall control their operations and the operations of their subcontractors and all suppliers to provide for the free and unobstructed movement of aircraft in the air operations areas (AOA) of the airport.

When the work requires the Contractor to conduct their operations within an AOA of the airport, the work shall be coordinated with airport operations (through the RPR) at least 48 hours prior to commencement of such work. The Contractor shall not close an AOA until so authorized by the RPR and until the necessary temporary marking, signage and associated lighting is in place as provided in Section 70, paragraph 70-08, *Construction Safety and Phasing Plan (CSPP)*.

When the contract work requires the Contractor to work within an AOA of the airport on an intermittent basis (intermittent opening and closing of the AOA), the Contractor shall maintain constant communications as specified; immediately obey all instructions to vacate the AOA; and immediately obey all instructions to resume work in such AOA. Failure to maintain the specified communications or to obey instructions shall be cause for suspension of the Contractor's operations in the AOA until satisfactory conditions are provided. The areas of the AOA identified in the Construction Safety Phasing Plan (CSPP) and as listed below, cannot be closed to operating aircraft to permit the Contractor's operations on a continuous basis and will therefore be closed to aircraft operations intermittently as follows:

See Attachment "A" to Section 70-08 - Construction Safety and Phasing Plan (CSPP) at the end of Section 70.

The Contractor shall be required to conform to safety standards contained in AC 150/5370-2, Operational Safety on Airports During Construction and the approved CSPP.

80-04.1 Operational safety on airport during construction. All Contractors' operations shall be conducted in accordance with the approved project Construction Safety and Phasing Plan (CSPP) and the Safety Plan Compliance Document (SPCD) and the provisions set forth within the current version of AC 150/5370-2, Operational Safety on Airports During Construction. The CSPP included within the contract documents conveys minimum requirements for operational safety on the airport during construction activities. The Contractor shall prepare and submit a SPCD that details how it proposes to comply with the requirements presented within the CSPP.

The Contractor shall implement all necessary safety plan measures prior to commencement of any work activity. The Contractor shall conduct routine checks to assure compliance with the safety plan measures.

The Contractor is responsible to the Owner for the conduct of all subcontractors it employs on the project. The Contractor shall assure that all subcontractors are made aware of the requirements of the CSPP and SPCD and that they implement and maintain all necessary measures.

No deviation or modifications may be made to the approved CSPP and SPCD unless approved in writing by the Owner. The necessary coordination actions to review Contractor proposed modifications to an approved CSPP or approved SPCD can require a significant amount of time.

If the Contractor requests changes to the CSPP and the requested changes are acceptable to the Owner, the Engineer, and the RPR, the Engineer will request a modification to the CSPP from the FAA. The Contractor shall plan on a minimum of 90 days for this process to be completed. No deviation to the original CSPP shall be made without FAA approval.

80-05 Character of workers, methods, and equipment. The Contractor shall, at all times, employ sufficient labor and equipment for prosecuting the work to full completion in the manner and time required by the contract, plans, and specifications.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform the work satisfactorily.

Any person employed by the Contractor or by any subcontractor who violates any operational regulations or operational safety requirements and, in the opinion of the RPR, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the RPR, be removed immediately by the Contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without approval of the RPR.

Should the Contractor fail to remove such person or persons, or fail to furnish suitable and sufficient personnel for the proper execution of the work, the RPR may suspend the work by written notice until compliance with such orders.

All equipment that is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the work shall not cause injury to previously completed work, adjacent property, or existing airport facilities due to its use.

When the methods and equipment to be used by the Contractor in accomplishing the work are not prescribed in the contract, the Contractor is free to use any methods or equipment that will accomplish the work in conformity with the requirements of the contract, plans, and specifications.

When the contract specifies the use of certain methods and equipment, such methods and equipment shall be used unless otherwise authorized by the RPR. If the Contractor desires to use a method or type of equipment other than specified in the contract, the Contractor may request authority from the RPR to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the RPR determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining work with the specified methods and equipment. The Contractor shall remove any deficient work and replace it with work of specified quality, or take such other corrective action as the RPR may direct. No change will be made in basis of payment for the contract items involved nor in contract time as a result of authorizing a change in methods or equipment under this paragraph.

80-06 Temporary suspension of the work. The Owner shall have the authority to suspend the work wholly, or in part, for such period or periods the Owner may deem necessary, due to unsuitable weather, or other conditions considered unfavorable for the execution of the work, or for such time necessary due to the failure on the part of the Contractor to carry out orders given or perform any or all provisions of the contract.

In the event that the Contractor is ordered by the Owner, in writing, to suspend work for some unforeseen cause not otherwise provided for in the contract and over which the Contractor has no control, the Contractor may be reimbursed for actual money expended on the work during the period of shutdown. No allowance will be made for anticipated profits. The period of shutdown shall be computed from the effective date of the written order to suspend work to the effective date of the written order to resume the work. Claims for such compensation shall be filed with the RPR within the time period stated in the RPR's order to resume work. The Contractor shall submit with their own claim information substantiating the amount shown on the claim. The RPR will forward the Contractor's claim to the Owner for consideration in accordance with local laws or ordinances. No provision of this article shall be construed as entitling the Contractor to compensation for delays due to inclement weather or for any other delay provided for in the contract, plans, or specifications.

If it becomes necessary to suspend work for an indefinite period, the Contractor shall store all materials in such manner that they will not become an obstruction nor become damaged in any way. The Contractor shall take every precaution to prevent damage or deterioration of the work performed and provide for normal drainage of the work. The Contractor shall erect temporary structures where necessary to provide for traffic on, to, or from the airport.

80-07 Determination and extension of contract time. The number of calendar days shall be stated in the proposal and contract and shall be known as the Contract Time.

If the contract time requires extension for reasons beyond the Contractor's control, it shall be adjusted as follows:

80-07.1 Contract time based on calendar days. Contract Time based on calendar days shall consist of the number of calendar days stated in the contract for each work area, counting from the effective date of the Notice to Proceed and including all Saturdays, Sundays, holidays, and non-work days. All calendar days elapsing between the effective dates of the Owner's orders to suspend and resume all work, due to causes not the fault of the Contractor, shall be excluded.

Time charged against the first work area shall begin on the date stated in the written Notice to Proceed. Time charged against subsequent work areas shall begin on the date and time stated in the NOTAMS issued for closure of the affected Work Area, at which time the Contractor may begin to place barricades, temporary jumpers, etc. for that Work Area.

Time charged against an individual Work Area shall end when the Engineer deems that work is substantially complete. Substantial completion of work in an individual Work Area is defined as the Work Area being fully operational and open to aircraft traffic, all barricades affecting the Work Area are removed, all temporary jumpers affecting the Work Area are removed, all pavements in the Work Area are cleaned, and NOTAMS affecting the completed Work Area are cancelled.

At the time of final payment, the contract time shall be increased in the same proportion as the cost of the actually completed quantities bears to the cost of the originally estimated quantities in the proposal. Such increase in the contract time shall not consider either cost of work or the extension of contract time that has been covered by a change order or supplemental agreement. Charges against the contract time will cease as of the date of final acceptance.

80-08 Failure to complete on time. (See the Contract Drawings for Section 80-08 verbiage.) For each calendar day or working day, as specified in the contract, that any work remains uncompleted after the contract time (including all extensions and adjustments as provided in paragraph 80-07, *Determination and Extension of Contract Time*) the sum specified in the contract and proposal as liquidated damages (LD) will be deducted from any money due or to become due the Contractor or their own surety. Such deducted sums shall not be deducted as a penalty but shall be considered as liquidation of a reasonable portion of damages including but not limited to additional engineering services that will be incurred by the Owner should the Contractor fail to complete the work in the time provided in their contract.

Schedule	Liquidated Damages Cost	Allowed Construction Time
Total Contract	$2,000	259 Calendar Days
Work Area A	$2,000	30 Calendar Days
Work Area B & C	$2,000	199 Calendar Days
Work Area D	$2,000	30 Calendar Days

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a wavier on the part of the Owner of any of its rights under the contract.

80-09 Default and termination of contract. The Contractor shall be considered in default of their contract and such default will be considered as cause for the Owner to terminate the contract for any of the following reasons, if the Contractor:

a. Fails to begin the work under the contract within the time specified in the Notice to Proceed, or

b. Fails to perform the work or fails to provide sufficient workers, equipment and/or materials to assure completion of work in accordance with the terms of the contract, or

c. Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or

d. Discontinues the execution of the work, or

e. Fails to resume work which has been discontinued within a reasonable time after notice to do so, or

f. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or

g. Allows any final judgment to stand against the Contractor unsatisfied for a period of 10 days, or

h. Makes an assignment for the benefit of creditors, or

i. For any other cause whatsoever, fails to carry on the work in an acceptable manner.

Should the Owner consider the Contractor in default of the contract for any reason above, the Owner shall immediately give written notice to the Contractor and the Contractor's surety as to the reasons for considering the Contractor in default and the Owner's intentions to terminate the contract.

If the Contractor or surety, within a period of 10 days after such notice, does not proceed in accordance therewith, then the Owner will, upon written notification from the RPR of the facts of such delay, neglect, or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the execution of the work out of the hands of the Contractor. The Owner may appropriate or use any or all materials and equipment that have been mobilized for use in the work and are acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the RPR will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Owner, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due the Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Owner the amount of such excess.

80-10 Termination for national emergencies. The Owner shall terminate the contract or portion thereof by written notice when the Contractor is prevented from proceeding with the construction contract as a direct result of an Executive Order of the President with respect to the execution of war or in the interest of national defense.

When the contract, or any portion thereof, is terminated before completion of all items of work in the contract, payment will be made for the actual number of units or items of work completed at the contract price or as mutually agreed for items of work partially completed or not started. No claims or loss of anticipated profits shall be considered.

Reimbursement for organization of the work, and other overhead expenses, (when not otherwise included in the contract) and moving equipment and materials to and from the job will be considered, the intent being that an equitable settlement will be made with the Contractor.

Acceptable materials, obtained or ordered by the Contractor for the work and that are not incorporated in the work shall, at the option of the Contractor, be purchased from the Contractor at actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the RPR.

Termination of the contract or a portion thereof shall neither relieve the Contractor of their responsibilities for the completed work nor shall it relieve their surety of its obligation for and concerning any just claim arising out of the work performed.

80-11 Work area, storage area and sequence of operations. See the Contract Drawings for Section 80-11 verbiage.

END OF SECTION 80

Section 90 Measurement and Payment

90-01 Measurement of quantities. All work completed under the contract will be measured by the RPR, or their authorized representatives, using United States Customary Units of Measurement.

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures (or leave-outs) having an area of 9 square feet (0.8 square meters) or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the RPR.

Unless otherwise specified, all contract items which are measured by the linear foot such as electrical ducts, conduits, pipe culverts, underdrains, and similar items shall be measured parallel to the base or foundation upon which such items are placed.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the contract. When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

When requested by the Contractor and approved by the RPR in writing, material specified to be measured by the cubic yard (cubic meter) may be weighed, and such weights will be converted to cubic yards (cubic meters) for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the RPR and shall be agreed to by the Contractor before such method of measurement of pay quantities is used.

Measurement and Payment Terms

Term	Description
Excavation and Embankment Volume	In computing volumes of excavation, the average end area method will be used unless otherwise specified.
Measurement and Proportion by Weight	The term "ton" will mean the short ton consisting of 2,000 pounds (907 kg) avoirdupois. All materials that are measured or proportioned by weights shall be weighed on accurate, independently certified scales by competent, qualified personnel at locations designated by the RPR. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material is paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty daily at such times as the RPR directs, and each truck shall bear a plainly legible identification mark.
Measurement by Volume	Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable for the materials hauled, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles

Term	Description
	shall be loaded to at least their water level capacity, and all loads shall be leveled when the vehicles arrive at the point of delivery.
Asphalt Material	Asphalt materials will be measured by the gallon (liter) or ton (kg). When measured by volume, such volumes will be measured at 60°F (16°C) or will be corrected to the volume at 60°F (16°C) using ASTM D1250 for asphalts. Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when asphalt material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work. When asphalt materials are shipped by truck or transport, net certified weights by volume, subject to correction for loss or foaming, will be used for computing quantities.
Cement	Cement will be measured by the ton (kg) or hundredweight (km).
Structure	Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.
Timber	Timber will be measured by the thousand feet board measure (MFBM) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.
Plates and Sheets	The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing will be specified and measured in decimal fraction of inch.
Miscellaneous Items	When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.
Scales	Scales must be tested for accuracy and serviced before use. Scales for weighing materials which are required to be proportioned or measured and paid for by weight shall be furnished, erected, and maintained by the Contractor, or be certified permanently installed commercial scales. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end. Scales shall be accurate within 0.5% of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the RPR before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed 0.1% of the nominal rated capacity of the scale, but not less than one pound (454 grams). The use of spring balances will not be permitted. In the event inspection reveals the scales have been “overweighing” (indicating more than correct weight) they will be immediately adjusted. All materials received subsequent to the last previous correct weighting-accuracy test will be reduced by the percentage of error in excess of 0.5%. In the event inspection reveals the scales have been under-weighing (indicating less than correct weight), they shall be immediately adjusted. No additional payment to the Contractor will be allowed for materials previously weighed and recorded. Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and the RPR can safely and conveniently view them.

Term	Description
	Scale installations shall have available ten standard 50-pound (2.3 km) weights for testing the weighing equipment or suitable weights and devices for other approved equipment. All costs in connection with furnishing, installing, certifying, testing, and maintaining scales; for furnishing check weights and scale house; and for all other items specified in this subsection, for the weighing of materials for proportioning or payment, shall be included in the unit contract prices for the various items of the project.
Rental Equipment	Rental of equipment will be measured by time in hours of actual working time and necessary traveling time of the equipment within the limits of the work. Special equipment ordered in connection with extra work will be measured as agreed in the change order or supplemental agreement authorizing such work as provided in paragraph 90-05 *Payment for Extra Work*.
Pay Quantities	When the estimated quantities for a specific portion of the work are designated as the pay quantities in the contract, they shall be the final quantities for which payment for such specific portion of the work will be made, unless the dimensions of said portions of the work shown on the plans are revised by the RPR. If revised dimensions result in an increase or decrease in the quantities of such work, the final quantities for payment will be revised in the amount represented by the authorized changes in the dimensions.

90-02 Scope of payment. The Contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all materials, for performing all work under the contract in a complete and acceptable manner, and for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the execution thereof, subject to the provisions of Section 70, paragraph 70-18, *No Waiver of Legal Rights*.

When the "basis of payment" subsection of a technical specification requires that the contract price (price bid) include compensation for certain work or material essential to the item, this same work or material will not also be measured for payment under any other contract item which may appear elsewhere in the contract, plans, or specifications.

90-03 Compensation for altered quantities. When the accepted quantities of work vary from the quantities in the proposal, the Contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract price for the accepted quantities of work actually completed and accepted. No allowance, except as provided for in Section 40, paragraph 40-02, *Alteration of Work and Quantities,* will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor which results directly from such alterations or indirectly from their own unbalanced allocation of overhead and profit among the contract items, or from any other cause.

90-04 Payment for omitted items. As specified in Section 40, paragraph 40-03, *Omitted Items,* the RPR shall have the right to omit from the work (order nonperformance) any contract item, except major contract items, in the best interest of the Owner.

Should the RPR omit or order nonperformance of a contract item or portion of such item from the work, the Contractor shall accept payment in full at the contract prices for any work actually completed and acceptable prior to the RPR's order to omit or non-perform such contract item.

Acceptable materials ordered by the Contractor or delivered on the work prior to the date of the RPR's order will be paid for at the actual cost to the Contractor and shall thereupon become the property of the Owner.

In addition to the reimbursement hereinbefore provided, the Contractor shall be reimbursed for all actual costs incurred for the purpose of performing the omitted contract item prior to the date of the RPR's order. Such additional costs incurred by the Contractor must be directly related to the deleted contract item and shall be supported by certified statements by the Contractor as to the nature the amount of such costs.

90-05 Payment for extra work. Extra work, performed in accordance with Section 40, paragraph 40-04, *Extra Work*, will be paid for at the contract prices or agreed prices specified in the change order or supplemental agreement authorizing the extra work.

Payment for extra work for "agreed prices" and for "time and materials" work shall be based on the following:

1. **Agreed Price/Time and Materials Work.** All agreed price and time and materials work shall be approved by the Owner and the FAA prior to proceeding with the work. The Engineer and Contractor shall be responsible for tracking the number of employees, number of hours and classification of each employee, numbers of hours that equipment is utilized and materials utilized for the extra work that is paid utilizing time and materials work.

   a. Miscellaneous. No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.

   b. Comparison of Record. The Contractor and the Engineer shall compare records of the cost of agreed price/time and materials work at the end of each day. Agreement shall be indicated by signature of the Contractor and the Engineer or their duly authorized representatives.

   c. Statement. No payment will be made for work performed on an agreed price/time and materials basis until the Contractor has furnished the Engineer with duplicate itemized statements of the cost of such agreed price/time and materials work detailed as follows:

      (1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.

      (2) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.

         (a) Contractor Owned Equipment Trucks and Plant.- Contractor shall be reimbursed for its ownership costs and for its operating costs for self owned equipment at the rates listed in the Rental Rate Blue Book published by Dataquest, Inc. applied in the following manner as modified by the "Rate Adjustment Table":

            (i) Ownership Costs -- It is mutually understood that the rates for ownership costs reimburse the Contractor for all non-operating costs of owning the equipment, truck or plant including depreciation on the original purchase, insurance, applicable taxes, interest on investment, storage, overhead, repairs, moving the equipment onto and away from the project or work site, and profit. Reimbursement will be made for the hours of actual use as described below.

            (ii) Less than 8 hours of actual use, the product of the actual number of hours used or fraction thereof multiplied by the hourly rate, or the daily rate, whichever is less.

            (iii) Between 8 hours and 40 hours of actual use, the product of the actual number of hours used divided by 8 multiplied by the daily rate, or the weekly rate, whichever is less.

(iv) Between 40 and 176 hours of actual use, the product of the actual number of hours used divided by 40 multiplied by the weekly rate, or the monthly rate, whichever is less.

(v) Over 176 hours of actual use, the product of the actual number of hours used divided by 176 multiplied by the monthly rate.

(vi) Operating Costs -- The rate for operating costs includes fuel, lubricants, other operating expendables, and preventative and field maintenance. Operating cost does not include the operator's wages. The Contractor shall be reimbursed the product of the number of hours of actual use multiplied by the Estimated Operating Cost/Hour.

(vii) The rates used shall be those in effect at the time the agreed price/time and materials work is done as reflected in the then current publication of the Rental Rate Blue Book. When agreed price/time and materials type analysis are used to establish agreed prices in accordance with paragraph A above, the rates used shall be those in effect when the agreed price is developed by the Contractor.

(viii) In the event that a rate is not established in the Rental Rate Blue Book for a particular piece of equipment, truck or plant, the Engineer shall establish rates for ownership costs and operating costs for that piece of equipment, truck or plant that is consistent with its cost and expected life.

(b) Rented Equipment, Trucks and Plant –

(i) In the event that the Contractor does not own a specific type of equipment and must obtain it by rental, it shall be paid the actual rental rate for the equipment for the time that the equipment is used to accomplish the work or is required by the Engineer to be present, not to exceed the adjusted rental rate in the Rental Rate Blue Book, plus the reasonable cost of moving the equipment onto and away from the project site.

(ii) The Contractor shall also be reimbursed for the operating cost of the equipment unless reflected in the rental price. Such operating cost shall be determined in the same manner as specified for Contractor Owned Equipment above.

(iii) In the event that area practice dictates the rental of equipment with an operator or fully fueled and maintained equipment, truck or plants, payment will be made on the basis of an invoice for the rental of the equipment with an operator, fully fueled and/or maintained equipment, trucks or plants including all costs incidental to its use, including costs of moving to and from the site, provided the rated is substantiated by area practice.

(c) Maximum Amount Payable -- The maximum amount of reimbursement for the ownership costs of Contractor owned or the rental cost of rented equipment, trucks or plant is limited to the original purchase price of the equipment, truck or plant for any agreed price/time and materials work as listed in the Green Guide for Construction Equipment published by the Dataquest, Inc. In the specific event when the ownership or rental reimbursement is limited by the original purchase price, the Contractor shall, nevertheless, be reimbursed for the operating Cost/Hour for each hour of actual use.

(3) Quantities of materials, prices, and extensions.

(4) Transportation of materials.

(5) Overhead and Profit. If any of the work is performed by a subcontractor, the Contractor shall be paid the actual and reasonable cost of such subcontracted work computed as outlined in a through d above, or on such other basis as may be approved by the Owner.

Overhead shall be defined to include, but not be limited to:

- premium on bonds;
- premium on insurance required by workman's compensation insurance, public liability and property damage insurance, unemployment insurance, social security tax, and other payroll taxes and such reasonable charges that are paid by the Contractor pursuant to written agreement with his/her employee;
- all salary and expenses of executive officers, supervising officers or supervising employees;
- all clerical or stenographic employees;
- all charges for minor equipment, such as small tools, including shovels, picks, axes, saws, bars, sledges, lanterns, jacks, cables, pails, wrenches, etc. and other miscellaneous supplies and services;
- all drafting room accessories such as paper, tracing cloth, blueprinting, etc.

90-06 Partial payments. Partial payments will be made to the Contractor at least once each month as the work progresses. Said payments will be based upon estimates, prepared by the RPR, of the value of the work performed and materials complete and in place, in accordance with the contract, plans, and specifications. Such partial payments may also include the delivered actual cost of those materials stockpiled and stored in accordance with paragraph 90-07, *Payment for Materials on Hand*. No partial payment will be made when the amount due to the Contractor since the last estimate amounts to less than five hundred dollars.

a. From the total of the amount determined to be payable on a partial payment, 10 percent of such total amount will be deducted and retained by the Owner for protection of the Owner's interests. Unless otherwise instructed by the Owner, the amount retained by the Owner will be in effect until the final payment is made except as follows:

(1) Contractor may request release of retainage on work that has been partially accepted by the Owner in accordance with Section 50-03. Contractor must provide a certified invoice to the RPR that supports the value of retainage held by the Owner for partially accepted work.

b. The Contractor is required to pay all subcontractors for satisfactory performance of their contracts no later than 30 days after the Contractor has received a partial payment. Contractor must provide the Owner evidence of prompt and full payment of retainage held by the prime Contractor to the subcontractor within 30 days after the subcontractor's work is satisfactorily completed. A subcontractor's work is satisfactorily completed when all the tasks called for in the subcontract have been accomplished and documented as required by the Owner. When the Owner has made an incremental acceptance of a portion of a prime contract, the work of a subcontractor covered by that acceptance is deemed to be satisfactorily completed.

c. When at least 95% of the work has been completed to the satisfaction of the RPR, the RPR shall, at the Owner's discretion and with the consent of the surety, prepare estimates of both the contract value and the cost of the remaining work to be done. The Owner may retain an amount not less than twice the contract value or estimated cost, whichever is greater, of the work remaining to be done. The remainder, less all previous payments and deductions, will then be certified for payment to the Contractor.

It is understood and agreed that the Contractor shall not be entitled to demand or receive partial payment based on quantities of work in excess of those provided in the proposal or covered by approved change orders or supplemental agreements, except when such excess quantities have been determined by the RPR to be a part of the final quantity for the item of work in question.

No partial payment shall bind the Owner to the acceptance of any materials or work in place as to quality or quantity. All partial payments are subject to correction at the time of final payment as provided in paragraph 90-09, *Acceptance and Final Payment*.

The Contractor shall deliver to the Owner a complete release of all claims for labor and material arising out of this contract before the final payment is made. If any subcontractor or supplier fails to furnish such a release in full, the Contractor may furnish a bond or other collateral satisfactory to the Owner to indemnify the Owner against any potential lien or other such claim. The bond or collateral shall include all costs, expenses, and attorney fees the Owner may be compelled to pay in discharging any such lien or claim.

No partial payments will be made for work items lacking approved submittals, or lacking acceptable manufacturer's material certifications.

Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of the Airport Sponsor. This clause applies to both DBE and non-DBE subcontractors.

Contractors shall include in their subcontracts language providing that Contractors and subcontractors will use appropriate alternative dispute resolution mechanisms to resolve payment disputes.

The Contractor will not be reimbursed for work performed by subcontractors unless and until the Contractor ensures that the subcontractors are promptly paid for the work they have performed.

The same requirement for prompt payment shall be applied to all tier subcontractors.

90-07 Payment for materials on hand. Partial payments may be made to the extent of the delivered cost of materials to be incorporated in the work, provided that such materials meet the requirements of the contract, plans, and specifications and are delivered to acceptable sites on the airport property or at other sites in the vicinity that are acceptable to the Owner. Such delivered costs of stored or stockpiled materials may be included in the next partial payment after the following conditions are met:

a. The material has been stored or stockpiled in a manner acceptable to the RPR at or on an approved site.

b. The Contractor has furnished the RPR with acceptable evidence of the quantity and quality of such stored or stockpiled materials.

c. The Contractor has furnished the RPR with satisfactory evidence that the material and transportation costs have been paid.

d. The Contractor has furnished the Owner legal title (free of liens or encumbrances of any kind) to the material stored or stockpiled.

e. The Contractor has furnished the Owner evidence that the material stored or stockpiled is insured against loss by damage to or disappearance of such materials at any time prior to use in the work.

It is understood and agreed that the transfer of title and the Owner's payment for such stored or stockpiled materials shall in no way relieve the Contractor of their responsibility for furnishing and placing such materials in accordance with the requirements of the contract, plans, and specifications.

In no case will the amount of partial payments for materials on hand exceed the contract price for such materials or the contract price for the contract item in which the material is intended to be used.

No partial payment will be made for stored or stockpiled living or perishable plant materials.

The Contractor shall bear all costs associated with the partial payment of stored or stockpiled materials in accordance with the provisions of this paragraph.

90-08 Payment of withheld funds. At the Contractor's option, if an Owner withholds retainage in accordance with the methods described in paragraph 90-06 *Partial Payments*, the Contractor may request that the Owner deposit the retainage into an escrow account. The Owner's deposit of retainage into an escrow account is subject to the following conditions:

a. The Contractor shall bear all expenses of establishing and maintaining an escrow account and escrow agreement acceptable to the Owner.

b. The Contractor shall deposit to and maintain in such escrow only those securities or bank certificates of deposit as are acceptable to the Owner and having a value not less than the retainage that would otherwise be withheld from partial payment.

c. The Contractor shall enter into an escrow agreement satisfactory to the Owner.

d. The Contractor shall obtain the written consent of the surety to such agreement.

e. Deposits in escrow shall be maintained for a period of time described in the subsection titled GUARANTY of this section, or the Contractor shall furnish a bond as described in the subsection titled SECURITY FOR GUARANTEE of this section.

90-09 Acceptance and final payment. When the contract work has been accepted in accordance with the requirements of Section 50, paragraph 50-15, *Final Acceptance*, the RPR will prepare the final estimate of the items of work actually performed. The Contractor shall approve the RPR's final estimate or advise the RPR of the Contractor's objections to the final estimate which are based on disputes in measurements or computations of the final quantities to be paid under the contract as amended by change order or supplemental agreement. The Contractor and the RPR shall resolve all disputes (if any) in the measurement and computation of final quantities to be paid within 30 calendar days of the Contractor's receipt of the RPR's final estimate. If, after such 30-day period, a dispute still exists, the Contractor may approve the RPR's estimate under protest of the quantities in dispute, and such disputed quantities shall be considered by the Owner as a claim in accordance with Section 50, paragraph 50-16, *Claims for Adjustment and Disputes*.

After the Contractor has approved, or approved under protest, the RPR's final estimate, and after the RPR's receipt of the project closeout documentation required in paragraph 90-11, *Contractor Final Project Documentation*, final payment will be processed based on the entire sum, or the undisputed sum in case of approval under protest, determined to be due the Contractor less all previous payments and all amounts to be deducted under the provisions of the contract. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

If the Contractor has filed a claim for additional compensation under the provisions of Section 50, paragraph 50-16, *Claims for Adjustments and Disputes,* or under the provisions of this paragraph, such claims will be considered by the Owner in accordance with local laws or ordinances. Upon final adjudication of such claims, any additional payment determined to be due the Contractor will be paid pursuant to a supplemental final estimate.

90-10 Construction warranty.

a. In addition to any other warranties in this contract, the Contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, workmanship, or design furnished, or performed by the Contractor or any subcontractor or supplier at any tier.

b. This warranty shall continue for a period of one year from the date of final acceptance of the work, except as noted. If the Owner takes possession of any part of the work before final acceptance, this warranty shall continue for a period of one year from the date the Owner takes possession. However, this will not relieve the Contractor from corrective items required by the final acceptance of the project work. Light Emitting Diode emitting diode (LED) light fixtures with the exception of obstruction lighting, must be warranted by the manufacturer for a minimum of four (4) years after date of installation inclusive of all electronics.

c. The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Owner real or personal property, when that damage is the result of the Contractor's failure to conform to contract requirements; or any defect of equipment, material, workmanship, or design furnished by the Contractor.

d. The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for one year from the date of repair or replacement.

e. The Owner will notify the Contractor, in writing, within seven (7) days after the discovery of any failure, defect, or damage.

f. If the Contractor fails to remedy any failure, defect, or damage within 14 days after receipt of notice, the Owner shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

g. With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall: (1) Obtain all warranties that would be given in normal commercial practice; (2) Require all warranties to be executed, in writing, for the benefit of the Owner, as directed by the Owner, and (3) Enforce all warranties for the benefit of the Owner.

h. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.

i. The Owner and Engineer will perform a warranty inspection with the Contractor approximately three (3) months before the end of the one year warranty period.

90-11 Contractor Final Project Documentation. Approval of final payment to the Contractor is contingent upon completion and submittal of the items listed below. The final payment will not be approved until the RPR approves the Contractor's final submittal. The Contractor shall:

a. Provide two (2) copies of all manufacturers warranties specified for materials, equipment, and installations.

b. Provide weekly payroll records (not previously received) from the general Contractor and all subcontractors.

c. Complete final cleanup in accordance with Section 40, paragraph 40-08, *Final Cleanup*.

d. Complete all punch list items identified during the Final Inspection.

e. Provide complete release of all claims for labor and material arising out of the Contract.

f. Provide a certified statement signed by the subcontractors, indicating actual amounts paid to the Disadvantaged Business Enterprise (DBE) subcontractors and/or suppliers associated with the project.

g. When applicable per state requirements, return copies of sales tax completion forms.

h. Manufacturer's certifications for all items incorporated in the work.

i. All required record drawings, as-built drawings or as-constructed drawings.

j. Project Operation and Maintenance (O&M) Manual(s). The Contractor shall prepare a project O&M Manual for the Owner. The O&M Manual shall consist of approved certification submittals, approved shop and setting drawing submittals, approved catalogue data submittals, circuit test results in accordance with Item L-108, and O&M Manuals for equipment installed that have operating procedures and/or maintenance requirements associated with them. The O&M manual shall be neatly bound in a properly sized 3-ring binder and tabbed by specification section. The O&M Manual shall be submitted to the Engineer prior to final payment to facilitate project closeout.

k. Security for Construction Warranty.

l. Equipment commissioning documentation submitted, if required.

m. Contractor's Affidavit of Payment of Debts and Claims (AIA Document G706) from the Prime Contractor.

n. Contractor's Affidavit of Release of Liens (AIA Document G706A) from the Prime Contractor.

o. Contractor's Affidavit of Payment of Debts and Claims (AIA Document G706) from each subcontractor.

p. Contractor's Affidavit of Release of Liens (AIA Document G706A) from each subcontractor.

q. Consent of Surety to Final Payment (AIA Document G707) from the Prime Contractor.

END OF SECTION 90

Special Provisions to the General Provisions

SP 30-09 Conformed Contract Documents. Conformed Contract Documents sent to the successful bidder for execution will consist of the original contract documents with a copy of the successful bidder's Proposal section inserted. In addition, the Form of Contract will be edited to include a contract date, the Contractor's name and address, the contract parts that are being awarded: Total Bid; Total Base Bid; Total Base Bid plus Add-On No. 1; Total Alternate No. 1 Bid plus Add-On No. 1; etc., the total contract amount awarded, the list of Addenda and dates, the contractor's company name on the signature page, a copy of the Contractor's Performance Bond, Labor and Material Payment Bond and Insurance Certificates will be inserted. The original completed and signed Proposal will be kept on file with the Owner or Engineer.

The Conformed Contracts Documents may incorporate changes to the General Provisions and the Technical Specifications which were made by addendum. If changes are so included, the addendum cover sheets will be included in the Conformed Contract Documents before the Table of Contents, otherwise the full addendum will be included before the Table of Contents.

The cover of the Contract Documents will be labeled "Conformed Contract".

SP 30-10 Issued for Construction Contract Documents. Issued for Construction (IFC) Contact Documents will be distributed prior to the start of construction. The IFC contract documents consist of the Conformed Contract Documents and the Contract Drawings. The IFC Contract Documents will include a copy of the executed Form of Contract. The original filled out and signed Form of Contract will be kept on file with the Owner or Engineer. The IFC Construction Drawings will incorporate any changes made by addendum during the bidding process.

The cover of the Contract Documents will be labeled "Conformed Contract" and "Issued for Construction". The title sheet of the Contract Drawings will be labeled "Issued for Construction".

SP 50-17 Additional Survey Requirements.

A. This work shall consist of providing all necessary survey work to establish, spatially position, and verify the locations of existing and proposed features and measure quantities of items in accordance with the contract documents or as directed by the RPR. This work includes but is not limited to the establishment, reestablishment or localization of primary and secondary control, the stakeout or layout of proposed features, the initialization, calibration and navigation of automated equipment operations, the location or verification of existing or of constructed features, the verification of geospatial data for proposed construction work and the coordination and sharing of survey data with the RPR.

The Contractor shall be responsible for trimming trees, brush and other objects from survey lines in advance of all survey work to permit accurate and unimpeded work by the survey crews.

B. Survey Reference Points.

1. Existing horizontal and vertical control points for the Project are those designated on drawings or as determined from investigation of the existing conditions.
2. Locate and protect control points prior to starting Site Work and preserve permanent reference points during construction.

a. Make no changes or relocations without prior approval of the RPR.

b. Report to RPR when reference point is lost, destroyed or requires relocation because of necessary changes in grades or locations.

c. Replace Project control points, which may be lost or destroyed. Airport control points shall be replaced in accordance with their requirements.

d. Existing property corners, markers, stakes, iron pins, and survey monuments defining property lines which have a high probability of being disturbed during construction shall be properly tied into fixed reference points before being disturbed. If disturbed, they shall be accurately reset in their proper position upon completion of the work.

C. Project Layout Requirements.

1. Establish a sufficient number of permanent bench marks on Site, as may be required, referenced to data established by survey control points. Record locations of benchmarks with horizontal and vertical data on Project Record Documents.

2. From established control points, layout all Work by establishing all lines and grades at Site necessary to control Work. Contractor shall be responsible for all measurements that may be required for execution of Work to location and limit marks prescribed in appropriate Specification Sections or on Contract Drawings.

3. Furnish, at contractor expense, all such stakes, steel pins, equipment, tools and material and labor that may be required in laying out Work control points.

4. Establish lines and levels. Locate and layout by instrumentation and similar appropriate means:

   a. Verify property, grades, lines, levels and dimensions indicated.

   b. Site Improvements

      1) Provide stakes for grading, fill and topsoil placement.

      2) Layout utility slopes and invert elevations.

      3) Layout limits of pavement demolition and proposed pavement.

4. Verify and coordinate in field all existing and proposed underground components including civil, structural, utilities and other components prior to initiation of the Work. Advise RPR and/or FAA of any conflicts or discrepancies.

D. Documents.

1. Submit name, address and contact information of Surveyor to RPR.

2. On request of the RPR, submit documentation to certify accuracy of construction survey and stakeout work and compliance with Contract Documents.

3. Submit certificate signed by licensed surveyor certifying that elevations and locations of improvements are in conformance with Contract Documents. Should any work be in non-conformance with Contract Documents, Contractor shall identify all such non-conformance in the certificate.

4. Standards and Availability: Data and other measurements shall be recorded in accordance with standard and approved methods. All field notes, sketches, recordings, and computations in establishing above horizontal and vertical control points shall be available at all times during progress of Work for ready examination by RPR.

5. Maintain complete and accurate record data on underground utilities and obstructions, new and existing, encountered in execution of Work. Record data on Project Record Documents.
6. On completion of major site improvements, prepare certified survey showing dimensions, locations, angles, and elevations of construction.

F. Computer Aided Drafting & Design (CADD) and 3D Surface files. This project was developed using three-dimensional design software. After award and upon request, the successful bidder will be provided CADD files developed from AutoCAD, and 3D surface files for use. The surface files will be provided for the existing grade, finished grade, and other applicable design surface models. In addition, survey control for the project will be provided in electronic format and the alignments will be provided in XML format. The files may be used for survey and stakeout of the project, but may not be manipulated. A single CADD file will be provided as well, including 2D and 3D information.

The following 3D surfaces will be provided:

SURFACE	DESCRIPTION
Overall Project Site Existing Grade	3D surface of project site overall existing grade elevations per topographic survey prior to construction.
Proposed Finished Grade	3D surface representation of the project site overall proposed finished grade elevations per project design. This surface includes pavement and turf grades.

The following 2D CADD files will be provided:

FILE	DESCRIPTION
Existing Base Map	Existing topographic features, limits of pavement, physical features, existing contours, equipment, structures, lights, signs, known utilities, fence, pipes, and conduits, buildings, etc.
Proposed	Proposed work including alignments, survey data, work phasing limits, limits of demolition, limits of pavement, physical features, proposed contours, equipment, structures, pavement marking, lights, signs, utilities, fence, pipes, and conduits, and buildings.

Unless otherwise shown on the Plans, the Contractor shall assume that the origin of proposed CAD symbols is at the center of the location of the feature.

The files were developed for the design and depiction of various 2D features (existing and proposed) and 3D features of existing, proposed, and subgrade surfaces. The surface files are depicted on the Contract Drawings in the form of contours, profiles, typical sections, spot elevations, tables, and other details. The surface file of the existing surface is the database of points from the design topographic survey. The surface files of the other surfaces are the database of points for the surfaces used to design the project.

The Owner allows use of the CADD and surface files in the performance of its work and services on the project with the following terms and conditions:

1. That the Owner does not warrant or guarantee the information and data in the CADD and surface files and any accompanying documentation as a substitute for the sound judgment of the Contractor.
2. That the Contractor desires to make use of the CADD and surface files in conjunction with the Work to be provided to the Owner for the subject project.

3. That the Contractor has no rights to the information and data contained in the CADD and surface files or any translated or converted form of these files. The transfer shall not be considered to convey any proprietary interest in the information and data in the CADD and surface files or any translated or converted form of these files or subsequent version thereof.
4. That the information and data contained in the CADD and surface files or in any translated or converted form of these files shall not be used by the Contractor on any other project.
5. That the Contractor may not copy, distribute, sell, rent, sublicense or lease the CADD and surface files or any translated or converted form of these files or any accompanying documentation.
6. That no information or data contained in the CADD and surface files or any translated or converted form of these files shall be transferred in any electronic form without written permission of the Owner.
7. That after completion of the Work by the Contractor as part of this project, the Contractor shall remove the information and data contained in the CADD and surface files, or any translated or converted form of these files, from all of its electronic data processing systems. No electronic copies of the information and data contained in the CADD and surface files or any translated or converted form of these files shall be retained by the Contractor.
8. That the Contractor shall take all steps reasonably necessary to protect the CADD and surface files, or any translated or converted form of these files, from theft or use in a manner inconsistent with these terms and conditions.
9. That the Owner may terminate these terms and conditions at any time and the Contractor shall immediately remove the CADD and surface files, or any translated or converted form of these files, from their electronic data processing systems upon demand of the Owner.
10. That the Owner retains all rights not expressly granted. Nothing in these terms and conditions constitutes a waiver of the Owner's rights under any federal or state law.
11. That the Owner excludes any and all implied warranties, including warranties of merchantability and fitness for a particular purpose, and limits the Contractor's remedy to return of the CADD and surface files and documentation to the Owner for replacement.
12. That the Owner makes no warranty or representation, either express or implied, with respect to the CADD and surface files or accompanying documentation, including their quality, performance, merchantability, or fitness for a particular purpose. The CADD and surface files and documentation are provided "as is" and the Contractor assumes the entire risk as to their quality and performance.
13. That the Owner shall not be liable for any direct, indirect, special, incidental, or consequential damages arising out of the use of, inability to use, or any defect in the CADD and surface files or any translated or converted form of these files or any accompanying documentation.
14. That the Contractor shall indemnify and hold harmless the Owner, its officials and employees, and the RPR for any injury to the person or property of third parties arising out of the use of or any defect in the CADD and surface files or any translated or converted form of these files or any accompanying documentation.
15. That the Contractor shall indemnify and hold harmless the Owner, its officials and employees, and the RPR for any injury arising out of any infringement of the copyright law.
16. That the warranty and remedies set forth in these terms and conditions are exclusive and in lieu of all others, oral or written, express or implied.

17. That nothing contained in these terms and conditions shall be construed to represent or warrant that the Contractor has the right to reproduce or copy any or converted form of these files and the Contractor acknowledges that it has no right to reproduce and include copyright or trade secret notices, or patent rights on any copies, in whole or in part, in any form. All copies of each CADD and surface file remain the property of the Owner and any rights involving the copyright law as modified in 17 U.S.C. §101 et. seq. remain with the Owner.

G. Equipment.

1. Surveying Equipment. Upon request, the Contractor shall make available to the RPR, a rod, level, and tripod. The rod shall be telescoping rod, 15 feet in length with hundredth of a foot graduations. The level shall be self-leveling and have documentation demonstrating it has been calibrated within twelve months of the project's commencement.
2. Materials. Stakes used for construction layout shall be sound hardwood stakes having minimum dimensions of 1 inch by 1 inch by 4 feet in length.
3. GPS Inspection Units.
    a. GPS units provided for a single contract shall be of the same model and manufacturer; and shall include, and be licensed to operate, the same versions of GPS planning software, data collection software, navigation software, stakeout software and post processing software. All software provided (including firmware) shall be the most current available from the manufacturer at the time of delivery of the GPS units. GPS inspection units should be of the same manufacturer as those used by the Contractor. GPS units shall not be more than 2 years old from the date of manufacturing to the time of delivery. To verify the age of the GPS units, the Contractor shall provide a dated copy of the manufacturer's receipt(s) for the purchase, lease or rental of the units.
    b. GPS units shall include both standard USB cable and Bluetooth wireless technology for data transfer.
    c. Data shall be capable of being copied onto or from a removable industry standard data storage card (e.g.: secure digital SD Card). Each GPS Unit shall include 2 data storage cards, each with a minimum capacity of 4 GB each.
    d. GPS units shall include the ability to import/export and display point and alignment data which is in XML format, and also import graphics files which are in DGN or DXF format.
    e. GPS units shall have an internal, or modular, rechargeable battery system capable of operating a minimum of 8 hours (may include interchangeable batteries), and shall include a battery charger.
    f. GPS units shall include a hard or soft shell carry case, and all appropriate operation manuals.
4. Survey Grade GPS Inspection Units.
    a. The Contractor shall provide the RPR with one GPS Inspection Unit for use during the course of the project. GPS units shall be equipped to receive Global Positioning System (GPS), GLONASS and GNSS position data.
    b. GPS units shall be equipped to receive, and be capable of utilizing, Real Time Kinematics (RTK) correctional data (current version of RTCM format) through internet protocol as provided from the Continuously Operating Reference System (CORS) Network. This shall include all necessary communication devices, repeaters and systems, data service plans and communications to meet the minimum required accuracy and not

exceed a 2 second latency at the rover. Whichever communication method is utilized by the Contractor to broadcast the CORS RTK correctional data, the Contractor shall ensure that the RTK data shall be available at all locations across the entire contract site during all hours of construction and inspection operations.

c. GPS units shall include the capability to "localize" both the horizontal and vertical control to local project monumentation (also known as calibrate), while utilizing RTK corrections from a reference network.

d. GPS units shall include either an integrated or modular communication device capable of receiving RTK correctional data to satisfy the requirement of using CORS RTK corrections.

e. GPS units shall have the ability to display the number of satellites tracked at any one time, and indicate the accuracy quality of each measurement relative to the strength of signals, and the GDOP (Geometric Dilution of Precision).

f. GPS Unit shall include dual frequency receivers.

g. Minimum Required Kinematic Accuracy relative to primary project control (CORS): Horizontal: 0.033 ft. + 1.0 ppm; Vertical: 0.065 ft. + 1.0 ppm

h. All necessary hardware and software shall be included (including communication drivers) to connect the GPS unit to a Tablet PC and communicate/exchange positional data with CADD software.

i. The data controller shall permit the user to program and store multiple configurations (also known as user preferences) prior to the actual field measurements. Configurations shall be capable of being stored and recalled in the field.

j. GPS units shall include one fixed height rover rod of 6.56 feet in length, one attachable bipod which is compatible with the rover rod, and one topo shoe.

k. A GPS unit set up to operate as a base station shall include all necessary additional cables, hardware, fasteners or accessories necessary to install it in a fixed semi-permanent location, will not be considered as a rover unit, and therefore will not require a rover rod, a bi-pod, or a topo shoe.

H. Verification of Existing Grades. This project was developed using a 3D CADD program. The 3D CADD program created 3D surface files of the existing surfaces, finished surfaces and other various surfaces required to complete the design.

Some volumetric quantities were calculated by comparing surface files of the applicable design surfaces and generating Triangle Volume Reports.

Existing grades on the surface files, where they do not match the locations of actual spot elevations shown on the topographic map, were developed by computer interpolation from those spot elevations. Prior to disturbing original grade, a Licensed Surveyor shall verify the accuracy of the existing ground surface by verifying spot elevations at the same locations where original field survey data was obtained as indicated on the topographic map. For this purpose, the RPR will provide the Contractor with a 3D CADD file of the topographic survey. Surveyor shall recognize that, due to the interpolation process, the actual ground surface at any particular location may differ somewhat from the interpolated surface shown on the design cross sections or obtained from the surface files. Surveyor's verification of original ground surface, however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be made to the original ground surface unless the Surveyor demonstrates that spot elevations shown are incorrect. For this purpose, spot elevations which are within 0.1 foot of the stated elevations for ground surfaces, or within 0.02 foot for hard

surfaces (pavements, buildings, foundations, structures, etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of the original ground surface. If Surveyor's verification identifies discrepancies in the topographic map, Contractor shall notify RPR in writing at least two weeks before disturbance of existing grade to allow sufficient time to verify the submitted information and make adjustments to the design cross sections or surface files. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of the accuracy of the original elevations shown on the topographic map for that area.

The Contractor's survey shall not exceed the following:

- Error of horizontal closure in feet shall not exceed 1 foot/5,000 feet
- Error of vertical closure in feet shall not exceed (0.05 feet)*(bench run length in miles)$^{1/2}$

A point data file of the Contractor's verification of original ground surface shall be provided in electronic format along with a printed hard copy. The point data shall be supplied in one ASCII file containing point number, northing, easting, elevation and descriptor. The data shall be left justified columns separated by commas with decimal points, but no slashes, colons and/or other separators.

J. Traditional Survey Stakeout. The Contractor shall field locate all features to be constructed from survey control points which are identified on the Plans. Any error, apparent discrepancy or absence in the data shown or required to appropriately accomplish the stakeout survey shall be referred to the RPR immediately for interpretation when such is observed or required.

The Contractor shall place two offset stakes or references points along the center line at maximum intervals of 50 feet and at such intermediate locations as required to determine location and direction. From computations and measurements made by the Contractor, these stakes shall be clearly and legibly marked with the center line station number, offset and cut or fill from which the establishment of the centerline location and elevation can be determined. If markings become illegible for any reason the markings shall be restored by the Contractor. The Contractor shall locate and place all cut, fill, slope, fine grade, or other stakes and points for the proper progress of the work with a maximum station spacing of 50 feet. All control points shall be properly protected and flagged for easy identification.

The Contractor shall be responsible for the accuracy of the work and shall maintain all applicable reference points, stakes, etc. Damaged or destroyed reference points or bench marks made inaccessible by the progress of the construction shall be replaced or transferred by the Contractor. All control points shall be referenced by ties (4 minimum) to specific points on acceptable objects and recorded. Any alterations or revisions in the ties shall be so noted and the information furnished to the RPR. All stakeout survey work related to control shall be referenced to the control line shown in the contract documents. Computations and survey notes necessary to establish the position of the work from control points, shall be made and maintained in a neat, legible and acceptable format by the Contractor. Computations, survey notes and other survey information shall be made available to the RPR within 3 work days from the request. The RPR may check all or any portion of the stakeout survey work or notes made by the Contractor. Such checking by the RPR shall not relieve the Contractor of any responsibilities for the accuracy or completeness of the work.

SP 50-18 Removal of water. The Contractor shall at all times during construction, provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work or the proper placing of materials or other work.

Removal of water includes the construction and removal of cofferdams, sheeting and bracing, the furnishing of materials and labor necessary therefore, the excavation and maintenance of ditches and

sluiceways and the furnishing and operation of pumps, wellpoints and appliances needed to maintain thorough drainage of the work in a satisfactory manner.

Water shall not be allowed to rise over or come in contact with any masonry, concrete or mortar, until at least twenty-four (24) hours after placement and no stream of water shall be allowed to flow over such work until such time as the RPR may permit.

Unless otherwise specified, all excavations which extend down to or below the static groundwater elevations at the sites of structures shall be dewatered by lowering and maintaining the groundwater beneath such excavations at an elevation not less than that specified herein at all times when work thereon is in progress, during subgrade preparation and the placing of the structure or other materials thereon.

Where the presence of fine granular subsurface materials and a high groundwater table may cause the upward flow of water into the excavation with a resulting quick condition, the Contractor shall install and operate a suitable dewatering system to prevent the upward flow of water during construction.

When the water table is within the capillary rise of silt/clay subsurface material, the Contractor shall select and operate his equipment in a manner to prevent the deterioration of the working surface due to the upward flow of water during construction.

The effluent pumped from the dewatering system shall be examined periodically by qualified personnel to determine if the system is operating satisfactorily without the removal of fines.

Unless otherwise directed by the RPR or shown on the Contract Documents, the water level shall not be permitted to rise until construction in the immediate area is completed and the excavation backfilled to the original grade or proposed grade.

Where well points are used, the groundwater shall be lowered and maintained continuously (day and night) at a level not less than two (2) feet below the bottom of the excavation. Excavation will not be permitted at a level lower than two (2) feet above the water level as indicated by the observation wells.

The wellpoint system shall be designed or installed by or under the supervision of an organization whose principal business is wellpointing and has at least five (5) consecutive years of similar experience and can furnish a representative list of satisfactory similar operations. Wellpoint headers, points and other pertinent equipment shall not be placed within the limits of the excavation in such a manner or location as to interfere with the laying of pipe or trenching operations or with the excavation for and/or construction of other structures. Standby gasoline or diesel powered equipment shall be provided so that in the event of failure of the operating equipment, the standby equipment can be readily connected to the dewatering system. The standby equipment shall be maintained in good order and actuated regularly not less than twice a week when directed.

Wellpoints shall be installed in the center of a sand wick drain which shall be placed by means of a sanding shell or other approved means to provide a sand core not less than ten (10) inches in diameter.

Detached observation wells of similar construction to the wellpoints shall be installed at intervals of not less than fifty (50) feet along the opposite side of the trench from the header pipe and line of wellpoints, or around the excavation for a structure or as shown on the Contract Drawings, to a depth of at least five (5) feet below the proposed excavation. In addition, one wellpoint in every fifty (50) feet shall be fitted with a tee, plug and valve so that the wellpoint can be converted for use as an observation well. Observation wells shall be not less than one and one-half (12) inch in diameter.

Water pumped or drained from excavations, or any sewers, drains, or water courses encountered in the work, shall be disposed of in a suitable manner without injury to adjacent property, the work under construction, or to pavements, roads and drives. No water shall be discharged to sanitary sewers. Sanitary sewage shall be pumped to sanitary sewers or shall be disposed of by an approved method.

Any damage caused by improper handling of water shall be repaired by the Contractor at his/her own expense.

SP 50-19 Sheeting and bracing. The Contractor shall furnish, place and maintain such sheeting, bracing and shoring as required to support the sides and ends of excavations in such a manner as to prevent any movement which would in any way damage the pipe, sewers, masonry or other work, diminish the width necessary, otherwise damage or delay the work, or endanger existing structures, pipes or pavements, or to occasion a hazard to persons engaged on the project or to the general public.

Sheeting and bracing or other trench protection shall be utilized as required for the safety of employees exposed to the hazard of falling or sliding material from any trench or excavation in conformance with the provisions of Industrial Code Rule 23 as amended, and OSHA. Sheeting and bracing must be designed by, signed and stamped by a Professional Engineer licensed to practice in the State in which the project is located.

The Contractor shall be responsible for the adequacy of all trench support systems used and for all damage to persons or property resulting from improper quality, strength, placing, maintenance and removal.

All material used for sheeting and bracing shall be sound and free from defects which might impair its strength or effectiveness.

All timber sheeting and bracing shall be sound and straight, free from cracks, shakes and large or loose knots.

All steel sheeting and bracing shall be sound and straight, free from bends, twists or splits, having square and undamaged ends.

Sheeting shall be driven vertically from the original ground surface as the excavation progresses. Sufficient toe support shall be sustained so as to maintain pressure against the original ground at all times.

Timber sheeting shall be driven so that edges are tight together and steel sheeting driven with the individual members interlocking. All bracing shall be of such design and strength as to maintain the sheeting in its proper position.

The Contractor shall be solely responsible for the adequacy of all sheeting and bracing.

In general, all sheeting and bracing, whether of steel, timber or other material, used to support the sides of trenches or other open excavations, shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a pipe, sewer or structure shall be withdrawn, unless otherwise directed, before more than 6 inches of earth is placed above the top of the pipe, sewer or structure and before any bracing is removed. The voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The Contractor shall be responsible for the adequate shoring and/or bracing of any existing utilities encountered during the excavation. Such utilities shall be braced or shored in a manner acceptable to the local jurisdictional agency having authority over the utility encountered. It shall be the responsibility of the Contractor to prevent damage to or displacement of utilities, and to work with and request the concurrence of the utility's company representative in this matter.

SP 60-09 Shop and setting drawings and catalogue data. All materials and equipment used in the work shall be submitted to the RPR, unless otherwise directed. The RPR will forward the submittals to Engineer for their review and approval prior to ordering the equipment. All information required for the Engineer's review of each particular pay item shall be sent as one submittal. In addition, if the pay item interfaces with other pay items (as in the case of electrical equipment), then the submittals covering the interfacing pay items shall be sent at the same time. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Drawings and data shall be submitted sufficiently in advance of the work to permit proper review, including time for necessary revisions and re-submittals. The Contractor is solely responsible for delays in the project accruing directly or indirectly from late submissions or resubmissions of submittals.

Shop and setting drawings shall present complete and accurate information relative to all working dimensions, equipment weight assembly and sectional view, all the necessary details, pertaining to coordinating the work of the Contract, lists of materials and finishes, parts lists and the description thereof, lists of spare parts and tools where such parts or tools are required, no-scale control diagrams for control wiring and control piping, and any other items of information that are required to demonstrate detail compliance with the Plans and Specifications. Each drawing shall be dated and shall show the name of the Project, Contract Number and the name of the manufacturer of the equipment covered by the drawing or drawings. The Engineer will not review any drawings that are not properly identified or that do not contain complete data on the work or that have not been checked, stamped and signed by the Contractor for compliance with the Contract Documents.

The Engineer's review of the Contractor's Shop Drawings signifies only that such drawings appear to be in substantial conformity with the Contract Drawings and Contract Documents. Such review does not indicate approval of every detail of the drawings nor of the work methods of the Contractor which are indicated thereon. Regardless of the corrections made in or made of such drawings by the Engineer, the Contractor will nevertheless be responsible for the accuracy of such drawings, for their conformity to the Plans and Specifications and for the proper fitting and construction of the work.

No work covered by shop and setting drawings shall be done until the drawings have been reviewed and found acceptable by the Engineer. No payment shall be made on any item for which submittals are not received and found acceptable by the Engineer.

SP 60-10 Electrical shop drawings. Drawings for electrical equipment shall show physical dimensions and installation details and shall include elementary and connection diagrams for each control assembly and the interconnection diagrams for all equipment. The drawings shall show clearly the coordination of control work, shall identify the components external to electrical equipment and shall define the contact arrangement and control action of the primary and final control elements.

Where standard electrical control equipment having complex internal wiring is required, such as control panels, generator transfer panels, electric or electronic instruments and similar items, the detail shop wiring diagrams for such equipment will not be required, and, if submitted, will in general not be reviewed. The submittal for each such item of equipment shall, however, include an elementary diagram of the input and output elements which require connections to external equipment, and/or a complete step by step description of the control action of the equipment being submitted. In the event that any questions arise as to the type of information to be presented on the submittal, the supplier shall direct inquiries to the RPR through the Prime Contractor in advance of the preparation of his/her submittal.

SP 60-11 Substitute items. If in the Engineer's sole judgment an item of material or equipment proposed by the Contractor does not qualify as an "or-equal" item, it will be considered a substitute item. The Contractor shall submit sufficient information as provided below to allow the Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. The procedure for review by the Engineer will include the following and as the Engineer may decide is appropriate under the circumstances. Requests for review of substitute items of material or equipment will not be accepted by the Engineer from anyone other than the Contractor. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor shall first make a written application through the RPR to the Engineer for acceptance thereof, certifying that the substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the substitute will prejudice the Contractor's achievement of completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents or Contract Drawings (or in the provisions of any other direct contract with the Owner for work on the Project) to adapt the design to the substitute and whether or not incorporation or use of the substitute in connection with the work is subject to payment of any license fee or royalty. If the substitute item requires modifications to any existing features or to any proposed work, the application shall also include details of proposed modifications necessary to accommodate the substitute item. Such details shall include scaled layouts, dimensions and other pertinent information to enable the Engineer to accurately assess the entire application. If the substitute item and proposed modifications are approved, the Contractor, at no additional cost to the Owner, shall do all work necessary to make such modifications and absorb all costs of any related changes imposed on other Contractor's. All variations of the substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by the Engineer in evaluating the substitute. The Engineer may require the Contractor to furnish additional data about the substitute.

A. **Engineer's Evaluation**. The Engineer will be the sole judge of acceptability. No substitute will be ordered, installed or utilized without the Engineer's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. The Engineer will record time required by the Engineer and the Engineer's Consultants in evaluating substitutes proposed or submitted by the Contractor and in making changes in the Contract Documents or Contract Drawings (or in the provisions of any other direct contract with Owner for work on the Project) occasioned thereby. The Engineer's charges shall be at the same rates the Engineer charges for such services to the Owner.

B. **Contractor's Expense.** All data to be provided by the Contractor in support of any substitute item will be at the Contractor's expense. In order to aid the Engineer in determining the equality of an or substitute item (when compared to the item actually specified), the Contractor shall arrange for the performance of any tests requested by the Engineer. The Engineer shall determine

the nature, extent, tester and degree of supervision of such tests. Certified test results shall be mailed directly to the Engineer for all tests requested. All costs of such tests, including engineering costs, shall be borne by the Contractor. The Owner may require the Contractor to furnish at the Contractor's expense a special performance guarantee or other surety with respect to any substitute. Whether or not the Engineer accepts a substitute item so proposed or submitted by the Contractor, the Contractor shall reimburse the Owner for the charges of the Engineer and the Engineer's Consultants for evaluating each such substitute item. The costs for evaluating substitute items shall be deducted from the Owner's payment to the Contractor.

SP 60-12 Submittal procedure. The following procedure has been established for the submittal and processing of shop and setting drawings, working drawings, and catalogue data. Departures from this procedure may result in delay and misunderstandings.

A. All information required for the Engineer's review of each particular pay item shall be sent as one submittal to the RPR with an attached submittal cover sheet. In addition, if the pay item interfaces with other pay items (as in the case of electrical equipment), then the submittals covering the interfacing pay items shall be sent at the same time.

B. Provide RPR with electronic copies when submitting certifications, drawings, catalog data, and similar items for review.
The submitted data will be retained by the Engineer, the RPR and the Contractor. The submittals received will be transmitted by the RPR, whenever possible, to each of the other prime Contractors whose work is to be correlated with such submittals. The RPR will transmit these submittals in order to facilitate each Contractor's coordination of their own work with that of the other Contracts.

C. For transmitting data for review, the letter of transmittal shall be sent to the RPR's office. Form letters may be used.

D. All correspondence other than simple transmittal of data shall be in triplicate.

E. Unless otherwise requested, a single copy of the correspondence emanating from the RPR's office will be sent. Additional copies of correspondence up to a maximum of four (4) copies will be provided, if requested.

F. Submittals will be stamped by the Engineer as follows:

1. "Approved", if no change or rejection is made.

2. "Approved as Noted", if minor changes or additions are made, but re-submittal is not considered necessary. All copies will bear the corrective marks.

3. "Revise and Resubmit", if the changes requested are extensive. In this case, re-submittal after correction is necessary and the same number of copies shall be included in the re-submittal as in the first submittal.

4. "Rejected", if it is considered that the data submitted cannot with reasonable revision meet the requirements of the Plans and Specifications.

5. "Submit Specified Item", if the data submitted is not clear, complete, or for other reasons cannot be examined by the Engineer to establish compliance with the Plans and Specifications.

G. Unless otherwise approved in specific cases, all submittals must be transmitted by the Prime Contractor, not by the Subcontractors or vendors.

H. In submitting certifications, drawings, catalog data, and similar items for review, one (1) electronic copy shall be submitted via e-mail. One (1) electronic copy will be returned to the Contractor via e-mail and bearing the review stamp. The Contractor shall provide one (1) hard copy of each submittal for inclusion in the O&M Manual prior to contract closeout.

The RPR shall be responsible for printing sufficient copies of each submittal for their own records. The Contractor shall be responsible for printing sufficient copies of each submittal for their own records and distributing to each of the other prime or subcontractors whose work is to be correlated with such submittals.

I. Submittals will be stamped by the Engineer as follows:

1. "Approved", if no change or rejection is made.

2. "Approved as Noted", if minor changes or additions are made, but re-submittal is not considered necessary. All copies will bear the corrective marks.

3. "Revise and Resubmit", if the changes requested are extensive. In this case, re-submittal after correction is necessary and the same number of copies shall be included in the re-submittal as in the first submittal.

4. "Rejected", if it is considered that the data submitted cannot with reasonable revision meet the requirements of the Plans and Specifications.

5. "Submit Specified Item", if the data submitted is not clear, complete, or for other reasons cannot be examined by the Engineer to establish compliance with the Plans and Specifications.

J. Unless otherwise approved in specific cases, all submittals must be transmitted by the Prime Contractor, not by the Subcontractors or vendors.

K. In submitting certifications, drawings, catalog data, and similar items for review, one (1) electronic copy shall be submitted to OneDrive. Access to OneDrive will be provided by the RPR upon award of the Contract. The submittal will be reviewed by the Engineer, stamped and signed. The submittal bearing the reviewed stamp and signature will be reloaded back to OneDrive by the Engineer. It will be the Contractor’s responsibility to check OneDrive for updated submittals.

The Contractor shall provide one (1) hard copy of each of the stamped and signed submittals for inclusion in the O&M Manual prior to contract closeout.

The RPR shall be responsible for printing sufficient copies of each submittal for their own records. The Contractor shall be responsible for printing sufficient copies of each submittal for their own records and distributing to each of the other prime or subcontractors whose work is to be correlated with such submittals.

L. Submittals will be stamped by the Engineer as follows:

1. "Approved", if no change or rejection is made.

2. "Approved as Noted", if minor changes or additions are made, but re-submittal is not considered necessary. All copies will bear the corrective marks.

3. "Revise and Resubmit", if the changes requested are extensive. In this case, re-submittal after correction is necessary and the same number of copies shall be included in the re-submittal as in the first submittal.

4. "Rejected", if it is considered that the data submitted cannot with reasonable revision meet the requirements of the Plans and Specifications.

5. "Submit Specified Item", if the data submitted is not clear, complete, or for other reasons cannot be examined by the Engineer to establish compliance with the Plans and Specifications.

M. Unless otherwise approved in specific cases, all submittals must be transmitted by the Prime Contractor, not by the Subcontractors or vendors.

Any changes in re-submittals, other than those indicated as requested, must be specifically brought to the attention of the RPR. Changes or additions shall not be made in, or to, any fabricated item, part or material without having a re-review.

SP 70-22 Additional sanitary, health, and safety provisions.

The Contractor shall promptly, and before the following conditions are disturbed, notify the Owner, in writing, of any:

1. Material that the contractor believes may be material that is hazardous waste, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law.

2. Subsurface or latent physical conditions at the site differing from those indicated by information about the site made available to bidders prior to the deadline for submitting bids.

3. Unknown physical conditions at the site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.

The Owner shall promptly investigate the conditions, and if it finds that the conditions do materially so differ, or do involve hazardous waste, and cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the work, shall issue a change order under the procedures described in the contract.

In the event that a dispute arises between the Owner and the Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the Contractor's cost of, or time required for, performance of any part of the work, the Contractor shall not be excused from any scheduled completion date provided for by the contract, but shall proceed with all work to be performed under the contract. The Contractor shall retain any and all rights provided either by contract or by law which pertain to the resolution of disputes and protests between the contracting parties.

SP 70-23 Federal Contract Provisions for procurement and contracting under AIP.

The Contractor is required to insert these contract provision in each lower tier contract (e.g. subcontract or sub-agreement).

The Contractor is required (including all subcontractors) to incorporate these contract provisions by reference for work done under any purchase orders, rental agreements and other agreements for supplies or services.

The Contractor shall be responsible for compliance with these contract provisions by any subcontractor, lower-tier subcontractor or service provider.

A1 ACCESS TO RECORDS AND REPORTS

ACCESS TO RECORDS AND REPORTS

The Contractor must maintain an acceptable cost accounting system. The Contractor agrees to provide the Owner, the Federal Aviation Administration and the Comptroller General of the United States or any of their duly authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to the specific contract for the purpose of making audit, examination, excerpts and transcriptions. The Contractor agrees to maintain all books, records and reports required under this contract for a period of not less than three years after final payment is made and all pending matters are closed.

A2 AFFIRMATIVE ACTION REQUIREMENT

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

   Timetables

   Goals for minority participation for each trade: %

   Goals for female participation in each trade: 6.9%

   These goals are applicable to all of the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its federally involved and non-federally involved construction.

   The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a)

and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs (OFCCP) within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

A3 BREACH OF CONTRACT TERMS

BREACH OF CONTRACT TERMS

Any violation or breach of terms of this contract on the part of the Contractor or its subcontractors may result in the suspension or termination of this contract or such other action that may be necessary to enforce the rights of the parties of this agreement.

Owner will provide Contractor written notice that describes the nature of the breach and corrective actions the Contractor must undertake in order to avoid termination of the contract. Owner reserves the right to withhold payments to Contractor until such time the Contractor corrects the breach or the Owner elects to terminate the contract. The Owner's notice will identify a specific date by which the Contractor must correct the breach. Owner may proceed with termination of the contract if the Contractor fails to correct the breach by the deadline indicated in the Owner's notice.

The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder are in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law.

A4 BUY AMERICAN PREFERENCE

BUY AMERICAN PREFERENCE

The Contractor certifies that its bid/offer is in compliance with 49 USC § 50101, BABA and other related Made in America Laws (Per Executive Order 14005 "Made in America Laws" means all statutes, regulations, rules, and Executive Orders relating to federal financial assistance awards or federal procurement, including those that refer to "Buy America" or "Buy American," that require, or provide a preference for, the purchase or acquisition of goods, products, or materials produced in the United States, including iron, steel, and manufactured products offered in the United States.), U.S. statutes, guidance, and FAA policies, which provide that Federal funds may not be obligated unless all iron, steel and

manufactured goods used in AIP funded projects are produced in the United States, unless the Federal Aviation Administration has issued a waiver for the product; the product is listed as an Excepted Article, Material Or Supply in Federal Acquisition Regulation subpart 25.108; or is included in the FAA Nationwide Buy American Waivers Issued list.

The bidder or offeror must complete and submit the certification of compliance with FAA's Buy American Preference, BABA and Made in America laws included herein with their bid or offer. The Airport Sponsor/Owner will reject as nonresponsive any bid or offer that does not include a completed certification of compliance with FAA's Buy American Preference and BABA.

The bidder or offeror certifies that all constructions materials, defined to mean an article, material, or supply other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives that are or consist primarily of: non-ferrous metals; plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables); glass (including optic glass); lumber; or drywall used in the project are manufactured in the U.S.

Certificate of Compliance with FAA Buy American Preference – Equipment/Building Projects

NOTE: Certification is included in the PROPOSAL.

A5 CIVIL RIGHTS – GENERAL

GENERAL CIVIL RIGHTS PROVISIONS

In all its activities within the scope of its airport program, the Contractor agrees to comply with pertinent statutes, Executive Orders, and such rules as identified in Title VI List of Pertinent Nondiscrimination Acts and Authorities to ensure that no person shall, on the grounds of race, color, national origin (including limited English proficiency), creed, sex (including sexual orientation and gender identity), age, or disability be excluded from participating in any activity conducted with or benefiting from Federal assistance.

This provision is in addition to that required by Title VI of the Civil Rights Act of 1964.

The above provision binds the Contractor and subcontractors from the bid solicitation period through the completion of the contract.

A6 CIVIL RIGHTS – TITLE VI ASSURANCE

Title VI Solicitation Notice:

The Sponsor, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 USC §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders or offerors that it will affirmatively ensure that for any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and no businesses will be discriminated against on the grounds of race, color, national origin (including limited English proficiency), creed, sex (including sexual orientation and gender identity), age, or disability in consideration for an award.

Title VI List of Pertinent Nondiscrimination Acts and Authorities

During the performance of this contract, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "Contractor") agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 USC § 2000d et seq., 78 stat. 252) (prohibits discrimination on the basis of race, color, national origin);
- 49 CFR part 21 (Non-discrimination in Federally-Assisted programs of the Department of Transportation—Effectuation of Title VI of the Civil Rights Act of 1964);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 USC § 4601) (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Section 504 of the Rehabilitation Act of 1973 (29 USC § 794 et seq.), as amended (prohibits discrimination on the basis of disability); and 49 CFR part 27 (Nondiscrimination on the Basis of Disability in Programs or Activities Receiving Federal Financial Assistance);
- The Age Discrimination Act of 1975, as amended (42 USC § 6101 et seq.) (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982 (49 USC § 47123), as amended (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987 (PL 100-259) (broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, the Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act of 1990 (42 USC § 12101, et seq) (prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities) as implemented by U.S. Department of Transportation regulations at 49 CFR parts 37 and 38;
- The Federal Aviation Administration's Nondiscrimination statute (49 USC § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (ensures nondiscrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations);
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must Guidelines for Contract Provisions for Obligated Sponsors and Airport Improvement Program Projects Issued on November 18, 2022 Page 22take reasonable steps to ensure that LEP persons have meaningful access to your programs [70 Fed. Reg. 74087 (2005)];

- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 USC § 1681, et seq).

Compliance with Nondiscrimination Requirements:

During the performance of this contract, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "Contractor"), agrees as follows:

1. **Compliance with Regulations:** The Contractor (hereinafter includes consultants) will comply with the Title VI List of Pertinent Nondiscrimination Acts and Authorities, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.

2. **Nondiscrimination:** The Contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor will not participate directly or indirectly in the discrimination prohibited by the Nondiscrimination Acts and Authorities, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR part 21.

3. **Solicitations for Subcontracts, including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding or negotiation made by the Contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the Contractor of the contractor's obligations under this contract and the Nondiscrimination Acts and Authorities on the grounds of race, color, or national origin.

4. **Information and Reports:** The Contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the sponsor or the Federal Aviation Administration to be pertinent to ascertain compliance with such Nondiscrimination Acts and Authorities and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the Contractor will so certify to the sponsor or the Federal Aviation Administration, as appropriate, and will set forth what efforts it has made to obtain the information.

5. **Sanctions for Noncompliance:** In the event of a Contractor's noncompliance with the non-discrimination provisions of this contract, the sponsor will impose such contract sanctions as it or the Federal Aviation Administration may determine to be appropriate, including, but not limited to:

    a. Withholding payments to the Contractor under the contract until the Contractor complies; and/or
    b. Cancelling, terminating, or suspending a contract, in whole or in part.

6. **Incorporation of Provisions:** The Contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations, and directives issued pursuant thereto. The Contractor will take action with respect to any subcontract or procurement as the sponsor or the Federal Aviation Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the Contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the Contractor may request the sponsor to enter into any litigation to protect the interests of the sponsor. In addition, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

A7 CLEAN AIR AND WATER POLLUTION CONTROL

CLEAN AIR AND WATER POLLUTION CONTROL

Contractor agrees to comply with all applicable standards, orders, and regulations issued pursuant to the Clean Air Act (42 USC §§ 740-7671q) and the Federal Water Pollution Control Act as amended (33 USC §§ 1251-1387). The Contractor agrees to report any violation to the Owner immediately upon discovery. The Owner assumes responsibility for notifying the Environmental Protection Agency (EPA) and the Federal Aviation Administration.

Contractor must include this requirement in all subcontracts that exceeds $150,000.

A8 CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS

1. Overtime Requirements.
No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic, including watchmen and guards, in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; Liability for Unpaid Wages; Liquidated Damages.
In the event of any violation of the clause set forth in paragraph (1) of this clause, the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this clause, in the sum of $29 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this clause.

3. Withholding for Unpaid Wages and Liquidated Damages.
The Federal Aviation Administration (FAA) or the Owner shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or

subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this clause.

4. Subcontractors.
The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs (1) through (4) and also a clause requiring the subcontractor to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1) through (4) of this clause.

A9 COPELAND "ANTI-KICKBACK" ACT

COPELAND "ANTI-KICKBACK" ACT

Contractor must comply with the requirements of the Copeland "Anti-Kickback" Act (18 USC 874 and 40 USC 3145), as supplemented by Department of Labor regulation 29 CFR part 3. Contractor and subcontractors are prohibited from inducing, by any means, any person employed on the project to give up any part of the compensation to which the employee is entitled. The Contractor and each Subcontractor must submit to the Owner, a weekly statement on the wages paid to each employee performing on covered work during the prior week. Owner must report any violations of the Act to the Federal Aviation Administration.

A10 DAVIS-BACON REQUIREMENTS

DAVIS-BACON REQUIREMENTS

1. Minimum Wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalent thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be

constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under (1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can easily be seen by the workers.

(ii)

(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination;
(2) The classification is utilized in the area by the construction industry; and
(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the Contractor, the laborers, or mechanics to be employed in the classification, or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(ii) (B) or (C) of this paragraph, shall be paid to all workers

performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *Provided*, that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program

2. Withholding.

The Federal Aviation Administration or the Sponsor shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Federal Aviation Administration may, after written notice to the Contractor, Sponsor, Applicant, or Owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and Basic Records.

(i) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker; his or her correct classification; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in 1(b)(2)(B) of the Davis-Bacon Act); daily and weekly number of hours worked; deductions made; and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records that show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual costs incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of

apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)

(A) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit the payrolls to the applicant, Sponsor, or Owner, as the case may be, for transmission to the Federal Aviation Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR § 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH–347 is available for this purpose from the Wage and Hour Division Web site at *http://www.dol.gov/esa/whd/forms/wh347instr.htm* or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker and shall provide them upon request to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit them to the applicant, Sponsor, or Owner, as the case may be, for transmission to the Federal Aviation Administration, the Contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, Sponsor, or Owner).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR § 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR § 5.5 (a)(3)(i), and that such information is correct and complete;

(2) That each laborer and mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(E) A pay application can not be deemed acceptable until all Contractor and subcontractor are submitted and approved by the Owner representative for the work period of the pay application.

(iii) The Contractor or subcontractor shall make the records required under paragraph (3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the Sponsor, the Federal Aviation Administration, or the Department of Labor and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the Contractor, Sponsor, applicant, or Owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR § 5.12.

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR § 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination that provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate that is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal Employment Opportunity. The utilization of apprentices, trainees, and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act Requirements.

The Contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

6. Subcontracts.

The Contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR §§ 5.5(a)(1) through (10) and such other clauses as the Federal Aviation Administration may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR § 5.5.

7. Contract Termination: Debarment.

A breach of the contract clauses in paragraph 1 through 10 of this section may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR § 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements.

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes Concerning Labor Standards.

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of Eligibility.

(i) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR § 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR § 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 USC § 1001.

A11 DEBARMENT AND SUSPENSION

CERTIFICATION OF OFFERER/BIDDER REGARDING DEBARMENT

By submitting a bid/proposal under this solicitation, the bidder or offeror certifies that neither it nor its principals are presently debarred or suspended by any Federal department or agency from participation in this transaction.

CERTIFICATION OF LOWER TIER CONTRACTORS REGARDING DEBARMENT

The successful bidder, by administering each lower tier subcontract that exceeds $25,000 as a "covered transaction", must verify each lower tier participant of a "covered transaction" under the project is not presently debarred or otherwise disqualified from participation in this federally assisted project. The successful bidder will accomplish this by:

1. Checking the System for Award Management at website: http://www.sam.gov.

2. Collecting a certification statement similar to the Certification of Offeror /Bidder Regarding Debarment, above.

3. Inserting a clause or condition in the covered transaction with the lower tier contract.

If the Federal Aviation Administration later determines that a lower tier participant failed to disclose to a higher tier participant that it was excluded or disqualified at the time it entered the covered transaction, the FAA may pursue any available remedies, including suspension and debarment of the non-compliant participant.

A12 DISADVANTAGED BUSINESS ENTERPRISE

A. Prime Contracts **(Projects Covered by a DBE Program)**

Contract Assurance (§ 26.13) –

The Contractor, subrecipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of DOT-assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate, which may include, but is not limited to:

1) Withholding monthly progress payments;
2) Assessing sanctions;
3) Liquidated damages; and/or
4) Disqualifying the Contractor from future bidding as non-responsible.

Prompt Payment (§26.29) – The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract no later than 30 days from the receipt of each payment the prime contractor receives from the Owner. The prime contractor agrees further to return retainage payments to each subcontractor within 30 days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of the Owner. This clause applies to both DBE and non-DBE subcontractors.

The Monthly Payment Report, found later in this section, is required to be submitted on a monthly basis throughout the entirety of the project. A progress payment will not be deemed complete and able to be processed until the reports are submitted. This report monitors the payments by providing a running tally of actual DBE attainments and compares this to the commitments.

The Monthly Payment Report, found later in this section, is required to be submitted along with a Disadvantaged Business Enterprise DBE Participation Summary for each DBE subcontractor on a monthly basis Subcontractor's Prompt Payment Certification throughout the entirety of the project. A progress payment will not be deemed complete and able to be processed until the reports are submitted. This report monitors the payments by providing a running tally of actual DBE attainments and compares this to the commitments.

The prime contractor is responsible for issuing the Subcontractor's Prompt Payment Certification to all subcontractors under this contract, and is required to ensure that all subcontractors issue the certificate to each of their subcontractors. Each subcontractor, DBE and non-DBE firms, are required to complete the Subcontractor's Prompt Payment Certification, found later in this section or electronically. A completed copy of this form shall be submitted to the Owner's representative, the Prime Contractor and the Contractor you are working for at least 7 days prior to an application for payment. This form is to be submitted with each payment application by every subcontractor, DBE and non-DBE firms until each subcontractor's work is complete and they have been paid in full and state so on their final Subcontractor's Prompt Payment Certification. Each Subcontractor's Prompt Payment Certificate must be received by the Owner's representative or the progress payment will not be deemed complete and able to be processed.

Monitoring Responsibilities (§26.37) – The prime contractor agrees to carry out all appropriate mechanisms to ensure compliance with 49 CFR Part 26 program requirements by all program participants, including monitoring of payments.

This project requires the following method to be utilized in tracking payments:

> The Monthly Payment Report, found later in this section, is required to be submitted on a monthly basis throughout the entirety of the project. This report monitors the payments by providing a running tally of actual DBE attainments and compares this to the commitments. This report is submitted monthly throughout the entirety of the project.
>
> The Disadvantaged Business Enterprise (DBE) Participation Summary Form, must be completed and signed by the DBE firm and Prime Contractor upon completion of the project. The intent of this form is to confirm total payments made to DBE firms.
> or
> Each sub-contractor, supplier must electronically acknowledge payments from the prime prior to the submission of the next pay application.

The following language in this section was taken from various sections of 49 CFR Part 26 titled Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs. They are not intended to be all encompassing, nor a comprehensive reiteration of the regulation.

A. The Sponsor has established a Disadvantaged Business Enterprise (DBE) program in accordance with regulations of the U.S. Department of Transportation (DOT), 49 CFR Part 26. The Sponsor has received, or will receive, Federal financial assistance from the Department of Transportation, and as a condition of receiving this assistance, the Sponsor has signed an assurance that it will comply with 49 CFR Part 26.

   It is the policy of the Sponsor to ensure that DBEs as defined in part 26, have an equal opportunity to receive and participate in DOT–assisted contracts. It is also the policy of the Sponsor:

   1. To ensure nondiscrimination in the award and administration of DOT – assisted contracts;
   2. To create a level playing field on which DBEs can compete fairly for DOT-assisted contracts;
   3. To ensure that the DBE Program is narrowly tailored in accordance with applicable law;
   4. To ensure that only firms that fully meet 49 CFR Part 26 eligibility standards are permitted to participate as DBEs;
   5. To help remove barriers to the participation of DBEs in DOT assisted contracts;
   6. To promote the use of DBEs in all types of federally-assisted contracts and procurement activities;
   7. To assist the development of firms that can compete successfully in the market place outside the DBE Program; and
   8. To make appropriate use of the flexibility afforded to recipients of Federal financial assistance in establishing and providing opportunities for DBEs.

B. The obligation of the bidder is to make good faith efforts. The bidder can demonstrate that it has done so either by meeting the contract goal or documenting good faith efforts. Examples of good faith efforts are found in Appendix A to Part 26. Determination whether the bidder has made a good faith effort will be made by the Sponsor's DBE Liaison Officer. The Contractor's DBE Plan must be acceptable to the Sponsor before entering into a contract with the bidder.

   Guidance pertaining to good faith efforts is provided in Appendix A to 49 CFR Part 26. In general, the bidder must demonstrate that they have taken all necessary and reasonable steps to achieve the identified DBE goal. The bidder should adequately document all such efforts, including contacts of DBE firms that are not interested.

   Good Faith Efforts:

   Bidder must demonstrate that they made good faith efforts to achieve participation with DBE firms. This requires that the bidder show that it took all necessary and reasonable steps to secure participation by certified DBE firms. Mere pro forma efforts will not be considered as a good faith effort.

Such actions constituting evidence of good faith efforts include but are not limited to:

- Soliciting DBE participation through all reasonable and available means. This may include but not limited to phone, emails, social media, public advertisements, outreach to known certified DBE firms.
- Researching the state's DBE directories to obtain a list of certified DBE firms.
- Selecting portions of work that increases the likelihood that DBE firms will be available to participate.
- Providing DBE firms with sufficient information and time to review the project pans and specifications.
- Documenting all contacts with DBE firms. This includes name, address, phone number, date of contact and record of conversation/negotiation.

C. Within 5 days of being informed by the Airport that it is not responsive because it has not documented sufficient good faith efforts, a bidder may request administrative reconsideration. Bidder/offerors should make this request in writing to the Sponsor's reconsideration official. The reconsideration official will not have played any role in the original determination that the bidder did not document sufficient good faith efforts.

Bidder/offerors should make this request in writing to:

Jeff Berghage, Facility Design & Construction Project Manager
Gerald R. Ford International Airport Authority
5500 44th St. SE
Grand Rapids, MI 49512
jberghage@grr.org

As part of this reconsideration, the bidder/offeror will have the opportunity to provide written documentation or argument concerning the issue of whether it met the goal or made adequate good faith efforts to do so. The bidder/offeror will have the opportunity to meet in person with the reconsideration official to discuss the issue of whether it met the goal or made adequate good faith efforts to do. We will send the bidder/offeror a written decision on reconsideration, explaining the basis for finding that the bidder did or did not meet the goal or make adequate good faith efforts to do so. The result of the reconsideration process is not administratively appealable to the Department of Transportation.

D. Termination of DBE Subcontracts (49 CFR § 26.53(f)) – The prime contractor must not terminate a DBE subcontractor listed in response to the Contractor's DBE Plan and DBE Letter of Intent Forms (or an approved substitute DBE firm) without prior written consent of the Owner. This includes, but is not limited to, instances in which the prime contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm.

The prime contractor shall utilize the specific DBEs listed to perform the work and supply the materials for which each is listed unless the contractor obtains written consent the Owner. Unless the Owner consent is provided, the prime contractor shall not be entitled to any payment for work or material unless it is performed or supplied by the listed DBE.

The Owner may provide such written consent only if the Owner agrees, for reasons stated in the concurrence document, that the prime contractor has good cause to terminate the DBE firm. For purposes of this paragraph, good cause includes the circumstances listed in 49 CFR §26.53.

Before transmitting to the Owner its request to terminate and/or substitute a DBE subcontractor, the prime contractor must give notice in writing to the DBE subcontractor, with a copy to the Owner, of its intent to request to terminate and/or substitute, and the reason for the request.

The prime contractor must give the DBE five days to respond to the prime contractor's notice and advise the Owner and the contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why the Owner should not approve the prime contractor's action. If required in a particular case as a matter of public necessity (e.g., safety), the Owner may provide a response period shorter than five days.

In addition to post-award terminations, the provisions of this section apply to preaward deletions of or substitutions for DBE firms put forward by offerors in negotiated procurements.

The Airport will require a contractor to make good faith efforts to replace a DBE that is terminated or has otherwise failed to complete its work on a contract with another certified DBE. These good faith efforts shall be directed at finding another DBE to perform at least the same amount of work under the contract as the DBE that was terminated, to the extent needed to meet the contract goal that we established for the procurement. The good faith efforts shall be documented by the contractor. If we request documentation from the contractor under this provision, the contractor shall submit the documentation to us within 7 days, which may be extended for an additional 7 days if necessary at the request of the contractor, and the recipient shall provide a written determination to the contractor stating whether or not good faith efforts have been demonstrated.

As stated in Contract Assurance § 26.13, failure by the contractor to carry out the requirements of this part is a material breach of the contract and may result in the termination of the contract or such other remedies set forth in that section that we deem appropriate if the prime contractor fails to comply with the requirements of this section.

If the contractor fails or refuses to comply in the time specified, our contracting office will issue an order stopping all or part of payment/work until satisfactory action has been taken. If the contractor still fails to comply, the contracting officer may issue a termination for default proceeding.

E. The sponsor will require the contractor to maintain records and documents of payments to DBEs for three years following the performance of the contract. These records will be made available for inspection upon request by any authorized representative of the Sponsor or DOT. This reporting requirement also extends to any certified DBE subcontractor.

F. Fostering Small Business Participation (49 CFR Part 26, §26.39).

The Sponsor has determined that an SBE program is not feasible for this Contract.

A13 DISTRACTED DRIVING

TEXTING WHEN DRIVING

In accordance with Executive Order 13513, "Federal Leadership on Reducing Text Messaging While Driving", (10/1/2009) and DOT Order 3902.10, "Text Messaging While Driving", (12/30/2009), the Federal Aviation Administration encourages recipients of Federal grant funds to adopt and enforce safety policies that decrease crashes by distracted drivers, including policies to ban text messaging while driving when performing work related to a grant or subgrant.

In support of this initiative, the Owner encourages the Contractor to promote policies and initiatives for its employees and other work personnel that decrease crashes by distracted drivers, including policies that ban text messaging while driving motor vehicles while performing work activities associated with the project. The Contractor must include the substance of this clause in all sub-tier contracts exceeding $10,000 that involve driving a motor vehicle in performance of work activities associated with the project.

A14 PROHIBITION ON CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT

Contractor and Subcontractor agree to comply with mandatory standards and policies relating to use and procurement of certain telecommunications and video surveillance services or equipment in compliance with the National Defense Authorization Act [Public Law 115-232 § 889(f)(1)].

A15 DRUG FREE WORKPLACE REQUIREMENTS

The Drug-Free Workplace Act of 1988 requires some Federal contractors and all Federal grantees to agree that they will provide drug-free workplaces as a condition of receiving a contract or grant from a Federal agency. The Act does not apply to contractors, subcontractors, or subgrantees, although the Federal grantee's workplace may be where the contractors, subcontractors, or subgrantees are working.

A16 EQUAL EMPLOYEMENT OPPORTUNITY (EEO)

EQUAL OPPORTUNITY CLAUSE

During the performance of this contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, sexual orientation, gender identify, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff, or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The

Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

(2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

(4) The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the agency contracting officer, advising the labor union or workers' representative of the Contractor's commitments under this section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(5) The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor .

(6) The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(7) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any such rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(8) The Contractor will include the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such

provisions, including sanctions for noncompliance: Provided, however, that in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS

1. As used in these specifications:

   a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;

   b. "Director" means Director, Office of Federal Contract Compliance Programs (OFCCP), U.S. Department of Labor, or any person to whom the Director delegates authority;

   c. "Employer identification number" means the Federal social security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941;

   d. "Minority" includes:

      (1) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

      (2) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race);

      (3) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

      (4) American Indian or Alaskan native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR part 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved plan is individually

required to comply with its obligations under the EEO clause and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved Plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through 7p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction contractors performing construction work in a geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

    a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

    b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

c. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source, or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.

f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination, or other employment decisions including specific review of these items with onsite supervisory personnel such superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other contractors and subcontractors with whom the Contractor does or anticipates doing business.

i. Direct its recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date

for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer, and vacation employment to minority and female youth both on the site and in other areas of a contractor's work force.

k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel, for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisor's adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations, which assist in fulfilling one or more of their affirmative action obligations (7a through 7p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the Contractor is a member and participant may be asserted as fulfilling any one or more of its obligations under 7a through 7p of these specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, sexual orientation, gender identity, or national origin.

11. The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination, and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR part 60-4.8.

14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government, and to keep records. Records shall at least include for each employee, the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g. those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

A17 FEDERAL FAIR LABOR STANDARDS ACT (FEDERAL MINIMUM WAGE)

SOLICITATION CLAUSE

All contracts and subcontracts that result from this solicitation incorporate by reference the provisions of 29 CFR part 201, the Federal Fair Labor Standards Act (FLSA), with the same force and effect as if given in full text. The FLSA sets minimum wage, overtime pay, recordkeeping, and child labor standards for full and part-time workers.

The Contractor has full responsibility to monitor compliance to the referenced statute or regulation. The Contractor must address any claims or disputes that arise from this requirement directly with the U.S. Department of Labor – Wage and Hour Division.

A18 LOBBYING AND INFLUENCING FEDERAL EMPLOYEES

NOTE: Certification is included in the PROPOSAL.

A19 PROHIBITION of SEGREGATED FACILITIES

PROHIBITION OF SEGREGATED FACILITIES

(a) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Employment Opportunity clause in this contract.

(b) "Segregated facilities," as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Employment Opportunity clause of this contract.

A20 OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

CONTRACT CLAUSE

All contracts and subcontracts that result from this solicitation incorporate by reference the requirements of 29 CFR Part 1910 with the same force and effect as if given in full text. The employer must provide a work environment that is free from recognized hazards that may cause death or serious physical harm to the employee. The employer retains full responsibility to monitor its compliance and their subcontractor's compliance with the applicable requirements of the Occupational Safety and Health Act of 1970 (29 CFR Part 1910). The employer must address any claims or disputes that pertain to a referenced requirement directly with the U.S. Department of Labor – Occupational Safety and Health Administration.

A21 PROCUREMENT OF RECOVERED MATERIALS

PROCUREMENT OF RECOVERED MATERIALS

Contractor and subcontractor agree to comply with Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, and the regulatory provisions of 40 CFR Part 247. In the performance of this contract and to the extent practicable, the Contractor and subcontractors are to use products containing the highest percentage of recovered materials for items designated by the Environmental Protection Agency (EPA) under 40 CFR Part 247 whenever:

1) The contract requires procurement of $10,000 or more of a designated item during the fiscal year; or

2) The contractor has procured $10,000 or more of a designated item using Federal funding during the previous fiscal year.

The list of EPA-designated items is available at www.epa.gov/smm/comprehensive-procurement-guidelines-construction-products.

Section 6002(c) establishes exceptions to the preference for recovery of EPA-designated products if the contractor can demonstrate the item is:

a) Not reasonably available within a timeframe providing for compliance with the contract performance schedule;

b) Fails to meet reasonable contract performance requirements; or

c) Is only available at an unreasonable price.

A22 RIGHT TO INVENTIONS

RIGHTS TO INVENTIONS

Contracts or agreements that include the performance of experimental, developmental, or research work must provide for the rights of the Federal Government and the Owner in any resulting invention as established by 37 CFR part 401, Rights to Inventions Made by Non-profit Organizations and Small Business Firms under Government Grants, Contracts, and Cooperative Agreements. This contract incorporates by reference the patent and inventions rights as specified within 37 CFR § 401.14. Contractor must include this requirement in all sub-tier contracts involving experimental, developmental, or research work.

A23 SEISMIC SAFETY

SEISMIC SAFETY

The Contractor agrees to ensure that all work performed under this contract, including work performed by subcontractors, conforms to a building code standard that provides a level of seismic safety substantially equivalent to standards established by the National Earthquake Hazards Reduction Program (NEHRP). Local building codes that model their code after the

current version of the International Building Code (IBC) meet the NEHRP equivalency level for seismic safety.

A24 TAX DELINQUENCY AND FELONY CONVICTIONS

NOTE: Certification is included in the PROPOSAL.

A25 TERMINATION OF CONTRACT

TERMINATION FOR CONVENIENCE (CONSTRUCTION & EQUIPMENT CONTRACTS)

The Owner may terminate this contract in whole or in part at any time by providing written notice to the Contractor. Such action may be without cause and without prejudice to any other right or remedy of Owner. Upon receipt of a written notice of termination, except as explicitly directed by the Owner, the Contractor shall immediately proceed with the following obligations regardless of any delay in determining or adjusting amounts due under this clause:

1. Contractor must immediately discontinue work as specified in the written notice.
2. Terminate all subcontracts to the extent they relate to the work terminated under the notice.
3. Discontinue orders for materials and services except as directed by the written notice.
4. Deliver to the Owner all fabricated and partially fabricated parts, completed and partially completed work, supplies, equipment and materials acquired prior to termination of the work, and as directed in the written notice.
5. Complete performance of the work not terminated by the notice.
6. Take action as directed by the Owner to protect and preserve property and work related to this contract that Owner will take possession.

Owner agrees to pay Contractor for:

1) completed and acceptable work executed in accordance with the contract documents prior to the effective date of termination;
2) documented expenses sustained prior to the effective date of termination in performing work and furnishing labor, materials, or equipment as required by the contract documents in connection with uncompleted work;
3) reasonable and substantiated claims, costs, and damages incurred in settlement of terminated contracts with Subcontractors and Suppliers; and
4) reasonable and substantiated expenses to the Contractor directly attributable to Owner's termination action.

Owner will not pay Contractor for loss of anticipated profits or revenue or other economic loss arising out of or resulting from the Owner's termination action.

The rights and remedies this clause provides are in addition to any other rights and remedies provided by law or under this contract.

TERMINATION FOR DEFAULT (CONSTRUCTION)

Section 80-09 of FAA Advisory Circular 150/5370-10 establishes conditions, rights, and remedies associated with Owner termination of this contract due to default of the Contractor.

TERMINATION FOR DEFAULT (EQUIPMENT)

The Owner may, by written notice of default to the Contractor, terminate all or part of this Contract if the Contractor:

1. Fails to commence the Work under the Contract within the time specified in the Notice- to-Proceed;
2. Fails to make adequate progress as to endanger performance of this Contract in accordance with its terms;
3. Fails to make delivery of the equipment within the time specified in the Contract, including any Owner approved extensions;
4. Fails to comply with material provisions of the Contract;
5. Submits certifications made under the Contract and as part of their proposal that include false or fraudulent statements; or
6. Becomes insolvent or declares bankruptcy.

If one or more of the stated events occur, the Owner will give notice in writing to the Contractor and Surety of its intent to terminate the contract for cause. At the Owner's discretion, the notice may allow the Contractor and Surety an opportunity to cure the breach or default.

If within 10 days of the receipt of notice, the Contractor or Surety fails to remedy the breach or default to the satisfaction of the Owner, the Owner has authority to acquire equipment by other procurement action. The Contractor will be liable to the Owner for any excess costs the Owner incurs for acquiring such similar equipment.

Payment for completed equipment delivered to and accepted by the Owner shall be at the Contract price. The Owner may withhold from amounts otherwise due the Contractor for such completed equipment, such sum as the Owner determines to be necessary to protect the Owner against loss because of Contractor default.

Owner will not terminate the Contractor's right to proceed with the Work under this clause if the delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such acceptable causes include: acts of God, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, and severe weather events that substantially exceed normal conditions for the location.

If, after termination of the Contractor's right to proceed, the Owner determines that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the Owner issued the termination for the convenience the Owner.

The rights and remedies of the Owner in this clause are in addition to any other rights and remedies provided by law or under this contract.

A26 TRADE RESTRICTION CERTIFICATION

NOTE: Certification is included in the PROPOSAL.

A27 VETERAN'S PREFERENCE

VETERAN'S PREFERENCE

In the employment of labor (excluding executive, administrative, and supervisory positions), the Contractor and all sub-tier contractors must give preference to covered veterans as defined within Title 49 United States Code Section 47112. Covered veterans include Vietnam-era veterans, Persian Gulf veterans, Afghanistan-Iraq war veterans, disabled veterans, and small business concerns (as defined by 15 USC § 632) owned and controlled by disabled veterans. This preference only applies when there are covered veterans readily available and qualified to perform the work to which the employment relates.

A28 DOMESTIC PREFERENCES FOR PROCUREMENTS

CERTIFICATION REGARDING DOMESTIC PREFERENCES FOR PROCUREMENTS

The Bidder or Offeror certifies by signing and submitting this bid or proposal that, to the greatest extent practicable, the Bidder or Offeror has provided a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including, but not limited to, iron, aluminum, steel, cement, and other manufactured products) in compliance with 2 CFR § 200.322.

SP 90-12 Security for construction warranty. The Contractor shall upon final acceptance of the work, furnish a bond to the Owner in a penal sum equal to five percent (5%) of the amount of the Contract price, executed by a surety company authorized by the Department of Insurance of the State of Michigan to execute such a bond in this State, and which bond shall be approved as to form and manner of execution by the Owner's attorney. This bond shall be conditioned for the faithful performance by the said Contractor of the conditions and stipulations of the subsection titled ACCEPTANCE AND FINAL PAYMENT of this section, thereof relating to maintenance and repair, for a period of one (1) year from the date of the final acceptance of the work. In default of the filing of such bond, a sum of money equal to said five percent (5%) may be retained out of any monies due to the Contractor and be held for one (1) year, or until the bond above described is filed.

For Contractors who have elected to set up an escrow account, they may elect to maintain the escrow account for a period of one (1) year from the date of final acceptance of the work in lieu of providing a bond for security of guarantee as described above.

MONTHLY PAYMENT REPORT

Name of Contractor's Firm: _____

Project Name/Location: _____

FAA AIP Project No.: _____

Subcontractor/DBE Supplier Name*	DBE Y/N	Subcontractor Contract Amount	Pay App #	Payment Period Date (From-To)	Amount Invoiced To Date	Amount Paid To Date	Current Retainage Amount	Total Retainage	Previous Payment Amount	Previous Payment Date	Total Payment Amount to Date

***ALL Subcontractors Must Be Listed – ONLY DBE Suppliers Must Be Listed**

_____ _____ _____

Signature of Contractor's Representative | Print Contractor's Representative | Date

SUBCONTRACTOR'S PROMPT PAYMENT CERTIFICATION

NOTE: Each Contractor shall provide a copy of this form to each of their Subcontractors (DBE and non-DBE) that are working on or has worked on this project. This certification applies to all tier Subcontractors. A completed copy of this form shall be submitted to the Sponsor's representative, the Prime Contractor and the Contractor you are working for at least 7 days prior to an application for payment. Any Subcontractor failing to submit a copy of this form shall be cause for the Sponsor's representative to delay the payment application. Reference Section 70-21, Item 12 for information on 49 CFR §26.29 with regard to Prompt Payment.

Should a Subcontractor indicate that they have not received payment for work they performed in which their Contractor has received payment, the Sponsor shall withhold the delinquent amount indicated unless the Contractor received written approval from the Sponsor of the Contractor's written request justifying withholding payment from the Subcontractor.

==========

Project Title:_____

Airport Name:_____

AIP No.:_____

Company Name: _____

Company Address: _____

_____ Contact Phone No.:_____

Contractor's Name you subcontract to: _____

==========

1. Have you performed work on this project within the last 30 days? Yes ___ No ___

2. Has the work you performed within the last 30 days been completed and accepted by the RPR? Yes ___ No ___ Not sure ____

3. Have you been paid by the contractor you subcontracted with for the work you performed? Yes ___ No ___

4. Estimated value of work performed in which you did not receive payment: $ _____

5. Have you completed all work that you are required to perform on this contact? Yes ___ No ___

Written Name of Subcontractor's Rep. _____

Signature:_____ Date:_____

DISADVANTAGED BUSINESS ENTERPRISE
DBE PARTICIPATION SUMMARY
(Submit one form for each DBE Firm.)

Airport Name: _____ **AIP No.** _____

Project Name: _____

Contractor: _____

Address: _____

City: _____ **State:** _____ **Zip:** _____

Contact Name: _____ **Phone:** _____

Email: _____

DBE Firm: _____

Address: _____

City: _____ **State:** _____ **Zip:** _____

Contact Name: _____ **Phone:** _____

Email: _____

Each DBE Firm shall submit evidence (such as a photocopy) of their certification status.

Classification:

- ☐ Prime Contractor
- ☐ Supplier
- ☐ Manufacturer
- ☐ Broker
- ☐ Subcontractor
- ☐ Joint Venture

Disadvantaged Group (check one):

- ☐ Black American
- ☐ Asian-Pacific American
- ☐ Hispanic American
- ☐ Non-Minority Women
- ☐ Native American
- ☐ Subcontinent Asian American
- ☐ Other (Please specify):

Summary of work performed:

Description of work	NAICS	Amount Paid to DBE

Contractor's Affirmation:
The Contractor utilized the above-named DBE Firm for the work items described above.

Initial Contract Amount: _____ **Difference:** _____
Explanation of Difference: (Additional documentation may be requested)

_____

_____

_____ _____ _____
Contractor's Signature **Title** **Date**

DBE Firm's Affirmation:
The above-named DBE Firm affirms that is has performed the work it was contracted to perform, as listed above and was paid in full as stated above.

_____ _____ _____
DBE Firm's Signature **Title** **Date**

SMALL BUSINESS PARTICIPATION PLAN	
Sponsor's Name:	
Airport Name:	
City, State:	
AIP Number:	
Federal Fiscal Year:	

In accordance with 49 CFR Part 26, §26.39, the following detailed list shall be completed by the Contractor for construction work items and professional services work items to be performed by all subcontractors and suppliers which will be involved in the work that qualify as a Small Business, whether registered as such, or not. The firms listed do not have to be certified DBE firms. This form shall be filled out and submitted to the Sponsor prior to the start of construction.

Small Business Firms to be Utilized (Name, Address, Phone)		Work to be Performed	Total Estimated Cost of Work
Name			
Address			
City, State, Zip			
Telephone			
Is the Firm DBE?	☐ Yes ☐ No		
Name			
Address			
City, State, Zip			
Telephone			
Is the Firm DBE?	☐ Yes ☐ No		
Name			
Address			
City, State, Zip			
Telephone			
Is the Firm DBE?	☐ Yes ☐ No		

SMALL BUSINESS PARTICIPATION PLAN
(cont'd)

Name			
Address			
City, State, Zip			
Telephone			
Is the Firm DBE?	☐ Yes ☐ No		
Name			
Address			
City, State, Zip			
Telephone			
Is the Firm DBE?	☐ Yes ☐ No		
Name			
Address			
City, State, Zip			
Telephone			
Is the Firm DBE?	☐ Yes ☐ No		
Name			
Address			
City, State, Zip			
Telephone			
Is the Firm DBE?	☐ Yes ☐ No		

(The Contractor may duplicate this form as necessary if additional space is required.)

The undersigned hereby assures that the information included herein is true and correct to the best of his/her knowledge, and that it is your intent to utilize these small business firm(s) listed for the work items noted.

By: _____ _____
(Contractor's Signature) (Title)

_____ _____
(Contractor's Printed Name) (Date)

Equal Employment Opportunity is
THE LAW

Private Employers, State and Local Governments, Educational Institutions, Employment Agencies and Labor Organizations

Applicants to and employees of most private employers, state and local governments, educational institutions, Employment agencies, and labor organizations are protected under Federal law from discrimination on the following bases.

RACE, COLOR, RELIGION, SEX, NATIONAL ORIGIN
Title VII of the Civil Rights Act of 1964, as amended, protects applicants and employees from discrimination in hiring, promotion, discharge, pay, fringe benefits, job training, classification, referral, and other aspects of employment, on the basis of race, color, religion, sex (including pregnancy), or national origin. Religious discrimination includes failing to reasonably accommodate an employee's religious practices where the accommodation does not impose undue hardship.

DISABILITIES
Title I and Title V of the Americans with Disabilities Act of 1990, as amended, protect qualified individuals from discrimination on the basis of disability in hiring, promotion, discharge, pay, fringe benefits, job training, classification, referral, and other aspects of employment. Disability discrimination includes not making reasonable accommodation to the known physical or mental limitations of an otherwise qualified individual with a disability who's is an applicant or employee, barring undue hardship.

AGE
The Age Discrimination in Employment Act of 1967, as amended, protects applicants and employees 40 years of age or older from discrimination based on age in hiring, promotion, discharge, pay, fringe benefits, job training, classification, referral, and other aspects of employment.

SEX (WAGES)
In addition to sex discrimination prohibited by Title VII of the Civil Rights Act, as amended, the Equal Pay Act of 1963, as amended, prohibits sex discrimination in payment of wages to women and men performing substantially equal work jobs that require equal skill, effort, and responsibility, under similar working conditions, in the same establishment.

GENETICS
Title II of the Genetic Information Nondiscrimination Act of 2008 protects applicants and employees from discrimination based on genetic information in hiring, promotion, discharge, pay, fringe benefits, job training, classification, referral, and other aspects of employment. GINA also restricts employers' acquisition of genetic information and strictly limits disclosure of genetic information. Genetic information includes information about genetic tests of applicants, employees, or their family members; the manifestation of diseases or disorders in family members (family medical history); and requests for or receipt of genetic services by applicants, employees, or their family members.

RETALIATION
All of these Federal laws prohibit covered entities from retaliating against a person who files a charge of discrimination, participates in a discrimination proceeding, or otherwise opposes an unlawful employment practice.

WHAT TO DO IF YOU BELIEVE DISCRIMINATION HAS OCCURRED
There are strict time limits for filing charges of employment discrimination. To preserve the ability of EEOC to act on your behalf and to protect your right to file a private lawsuit, should you ultimately need to, you should contact EEOC promptly when discrimination is suspected:
The U.S. Equal Employment Opportunity Commission (EEOC), 1-800-669-4000 (toll-free) or 1-800-669-6820 (toll-free TTY number for individuals with hearing empairments). EEOC field office information is available at www.eeoc.gov or in most telephone directories in the U.S. Government or Federal Government section.
Additional information about EEOC, including information about charge filing, is available at www.eeoc.gov.

Employers Holding Federal Contracts or Subcontracts

Applicants to and employees of companies with a Federal government contract or subcontract, are protected under Federal law from discrimination on the following bases.

RACE, COLOR, RELIGION, SEX, NATIONAL ORIGIN
Executive Order 11246, as amended, prohibits job discrimination on the basis of race, color, religion, sex or national origin, and requires affirmative action to ensure equality of opportunity in all aspects of employment.

INDIVIDUALS WITH DISABILITIES
Section 503 of the Rehabilitation Act of 1973, as amended, protects qualified individuals from discrimination on the basis of disability in hiring, promotion, discharge, pay, fringe benefits, job training, classification, referral, and other aspects of employment, Disability discrimination includes not making reasonable accommodation to the known physical or mental limitations of an otherwise qualified employee, barring undue hardship. Section 503 also requires that Federal contractors take affirmative action to employ and advance in employment qualified individuals with disabilities at all levels of employment, including the executive level.

DISABLED, RECENTLY SEPARATED, OTHER PROTECTED, AND ARMED FORCES SERVICE MEDAL VETERANS
The Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended, 38 U.S.C. 4212, prohibits job discrimination and requires affirmative action to employ and advance in employment disabled veterans, recently separated veterans (within three years of discharge or release from active duty), other protected veterans (veterans who served during a war or in a campaign or expedition for which a campaign badge has been authorized), and Armed Forces service medal veterans (veterans who, while on active duty, participated in a U.S. military operation for which an Armed Forces service medal was awarded).

RETALIATION
Retaliation is prohibited against a person who files a complaint of discrimination, participates in an OFCCP proceeding, or otherwise opposes discrimination under these Federal laws.

Any person who believes a contractor has violated its nondiscrimination or affirmative action obligations under the authorities above should contact immediately:

The Office of Federal Contract Compliance Programs (OFCCP), U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210, 1-800-397-6251 (toll-free) or (202) 693-1337 (TTY). OFCCP may also be contacted by e-mail at OFCCP-Public@dol.gov, or by calling an OFCCP regional or district office, listed in most telephone directories under U.S. Government, Department of Labor.

Programs or Activities Receiving Federal Financial Assistance

RACE, COLOR, NATIONAL ORIGIN, SEX
In addition to the protections of Title VII of the Civil Rights Act of 1964, as amended, Title VI of the Civil Rights Act of 1964, as amended, prohibits discrimination on the basis of race, color or national origin in programs or activities receiving Federal financial assistance. Employment discrimination is covered by Title VI if the primary objective of the financial assistance is provision of employment, or where employment discrimination causes or may cause discrimination in providing services under such programs. Title IX of the Education Amendments of 1972 prohibits employment discrimination on the basis of sex in educational programs or activities which receive Federal financial assistance.

INDIVIDUALS WITH DISABILITIES
Section 504 of the Rehabilitation Act of 1973, as amended, prohibits employment discrimination on the basis of disability in any program or activity which receives Federal financial assistance. Discrimination is prohibited in all aspects of employment against persons with disabilities who, with or without reasonable accommodation, can perform the essential functions of the job.

If you believe you have been discriminated against in a program of any institution which receives Federal financial assistance, you should immediately contact the Federal agency providing such assistance.

FEDERAL WAGE RATES

"General Decision Number: MI20230088 02/03/2023

Superseded General Decision Number: MI20220088

State: Michigan

Construction Type: Building

County: Kent County in Michigan.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least $16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least $12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this

wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2023
1	02/03/2023

ASBE0047-002 07/01/2022

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 34.62	18.58

BOIL0169-001 01/01/2021

	Rates	Fringes
BOILERMAKER	$ 35.95	34.52

BRMI0009-002 08/01/2020

	Rates	Fringes
TILE FINISHER	$ 22.80	17.54
TILE SETTER	$ 26.40	20.08

FOOTNOTE:

Paid Holiday: Fourth of July, if the worker has been employed by the contractor in any period of seven working days before said holiday within the current calendar year.

CARP1102-001 06/01/2019

	Rates	Fringes
MILLWRIGHT	$ 28.59	24.79

ENGI0324-035 06/01/2022

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1	$ 38.18	24.85
GROUP 2	$ 36.47	24.85
GROUP 3	$ 34.72	24.85

GROUP 4.....$ 30.61 24.85

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Concrete Pump; Grader/Blade; Highlift; Hoist; Roller; Scraper; Trencher

GROUP 2: Broom/Sweeper

GROUP 3: Boom Truck (non-swinging)

GROUP 4: Oiler

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* IRON0025-013 06/01/2022

	Rates	Fringes
IRONWORKER, REINFORCING	$ 31.43	34.77

LABO0355-027 06/01/2021

	Rates	Fringes
LABORER		
Grade Checker; Sandblaster	$ 24.90	12.95

PAIN0845-006 06/01/2022

	Rates	Fringes
PAINTER: Brush and Spray	$ 24.45	15.64

PLUM0174-002 07/01/2021

	Rates	Fringes
PIPEFITTER (Including HVAC Pipe Installation; Excluding HVAC System Installation)	$ 37.89	23.52
PLUMBER, Excludes HVAC Pipe and Unit Installation	$ 37.89	23.52

SHEE0007-014 05/01/2018

	Rates	Fringes
SHEET METAL WORKER, Excludes HVAC Duct and Unit Installation	$ 30.63	14.74

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* SUMI2011-013 02/01/2011

	Rates	Fringes
BRICKLAYER	$ 21.45	5.00
CARPENTER (Acoustical Ceiling Installation Only)	$ 18.61	2.69
CARPENTER (Drywall Finishing/Taping Only)	$ 17.35	2.69
CARPENTER (Drywall Hanging Only)	$ 16.28	2.69
CARPENTER (Form Work Only)	$ 18.62	6.42
CARPENTER, Excludes Acoustical Ceiling Installation, Drywall Finishing/Taping, Drywall Hanging, and Formwork	$ 18.14	4.59
CEMENT MASON/CONCRETE FINISHER	$ 17.16	4.25
ELECTRICIAN, Excludes Low Voltage Wiring	$ 20.68	6.39
GLAZIER	$ 15.29 **	2.68
HVAC MECHANIC (Installation of HVAC Unit Only, Excludes Installation of HVAC Pipe and Duct)	$ 16.75	2.75
IRONWORKER, ORNAMENTAL	$ 18.48	7.93
IRONWORKER, STRUCTURAL	$ 18.07	4.84
LABORER: Common or General	$ 13.04 **	4.80
LABORER: Landscape & Irrigation	$ 10.47 **	0.00
LABORER: Mason Tender - Brick	$ 18.87	2.16
LABORER: Mason Tender - Cement/Concrete	$ 14.01 **	2.45
LABORER: Pipelayer	$ 18.32	3.28
OPERATOR:		

Backhoe/Excavator/Trackhoe.....$ 20.23 9.10

OPERATOR: Bobcat/Skid
Steer/Skid Loader.....$ 16.50 6.17

OPERATOR: Bulldozer.....$ 18.50 5.81

OPERATOR: Crane.....$ 19.21 6.76

OPERATOR: Forklift.....$ 21.48 9.13

OPERATOR: Tractor.....$ 15.72 ** 1.92

OPERATOR: Loader.....$ 17.16 4.05

PAINTER: Roller.....$ 16.21 2.81

ROOFER.....$ 14.05 ** 6.06

SHEET METAL WORKER (HVAC Duct
Installation Only).....$ 18.32 4.66

SPRINKLER FITTER (Fire
Sprinklers).....$ 17.07 4.24

TRUCK DRIVER: Dump Truck.....$ 17.00 5.71

TRUCK DRIVER: Tractor Haul
Truck.....$ 13.57 ** 1.18

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 ($16.20) or 13658 ($12.15). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons

resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and

non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the

Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISIO"

END OF SPECIAL PROVISIONS

"General Decision Number: MI20230088 05/05/2023

Superseded General Decision Number: MI20220088

State: Michigan

Construction Type: Building

County: Kent County in Michigan.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2023
1	02/03/2023

ASBE0047-002 07/01/2022

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 34.62	18.58

BOIL0169-001 01/01/2021

	Rates	Fringes
BOILERMAKER	$ 35.95	34.52

BRMI0009-002 08/01/2020

	Rates	Fringes
TILE FINISHER	$ 22.80	17.54
TILE SETTER	$ 26.40	20.08

FOOTNOTE:

Paid Holiday: Fourth of July, if the worker has been employed by the contractor in any period of seven working days before said holiday within the current calendar year.

CARP1102-001 06/01/2019

	Rates	Fringes
MILLWRIGHT	$ 28.59	24.79

ENGI0324-035 06/01/2022

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1	$ 38.18	24.85
GROUP 2	$ 36.47	24.85
GROUP 3	$ 34.72	24.85
GROUP 4	$ 30.61	24.85

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Concrete Pump; Grader/Blade; Highlift; Hoist; Roller; Scraper; Trencher

GROUP 2: Broom/Sweeper

GROUP 3: Boom Truck (non-swinging)

GROUP 4: Oiler

IRON0025-013 06/01/2022

	Rates	Fringes
IRONWORKER, REINFORCING	$ 31.43	34.77

LABO0355-027 06/01/2021

	Rates	Fringes
LABORER		
Grade Checker; Sandblaster..	$ 24.90	12.95

PAIN0845-006 06/01/2022

	Rates	Fringes
PAINTER: Brush and Spray.....	$ 24.45	15.64

PLUM0174-002 07/01/2021

	Rates	Fringes
PIPEFITTER (Including HVAC Pipe Installation; Excluding HVAC System Installation).....	$ 37.89	23.52
PLUMBER, Excludes HVAC Pipe and Unit Installation.....	$ 37.89	23.52

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* SHEE0007-014 05/01/2023

	Rates	Fringes
SHEET METAL WORKER, Excludes HVAC Duct and Unit Installation.....	$ 35.41	15.86

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* SUMI2011-013 02/01/2011

	Rates	Fringes
BRICKLAYER.....	$ 21.45	5.00
CARPENTER (Acoustical Ceiling Installation Only).....	$ 18.61	2.69
CARPENTER (Drywall Finishing/Taping Only).....	$ 17.35	2.69
CARPENTER (Drywall Hanging Only).....	$ 16.28	2.69
CARPENTER (Form Work Only).....	$ 18.62	6.42
CARPENTER, Excludes Acoustical Ceiling Installation, Drywall Finishing/Taping, Drywall Hanging, and Formwork.....	$ 18.14	4.59
CEMENT MASON/CONCRETE FINISHER...	$ 17.16	4.25
ELECTRICIAN, Excludes Low Voltage Wiring.....	$ 20.68	6.39
GLAZIER.....	$ 15.29 **	2.68
HVAC MECHANIC (Installation of HVAC Unit Only, Excludes Installation of HVAC Pipe and		

Duct).....$ 16.75 2.75

IRONWORKER, ORNAMENTAL.....$ 18.48 7.93

IRONWORKER, STRUCTURAL.....$ 18.07 4.84

LABORER: Common or General.....$ 13.04 ** 4.80

LABORER: Landscape &
Irrigation.....$ 10.47 ** 0.00

LABORER: Mason Tender - Brick...$ 18.87 2.16

LABORER: Mason Tender -
Cement/Concrete.....$ 14.01 ** 2.45

LABORER: Pipelayer.....$ 18.32 3.28

OPERATOR:
Backhoe/Excavator/Trackhoe.....$ 20.23 9.10

OPERATOR: Bobcat/Skid
Steer/Skid Loader.....$ 16.50 6.17

OPERATOR: Bulldozer.....$ 18.50 5.81

OPERATOR: Crane.....$ 19.21 6.76

OPERATOR: Forklift.....$ 21.48 9.13

OPERATOR: Tractor.....$ 15.72 ** 1.92

OPERATOR: Loader.....$ 17.16 4.05

PAINTER: Roller.....$ 16.21 2.81

ROOFER.....$ 14.05 ** 6.06

SHEET METAL WORKER (HVAC Duct
Installation Only).....$ 18.32 4.66

SPRINKLER FITTER (Fire
Sprinklers).....$ 17.07 4.24

TRUCK DRIVER: Dump Truck.....$ 17.00 5.71

TRUCK DRIVER: Tractor Haul
Truck.....$ 13.57 ** 1.18

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 ($16.20) or 13658 ($12.15). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide

employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007

in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISIO"

Prevailing Wage Rates for State Funded Projects

Official Rates

Kent County

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Boilermaker						
Boilermaker	BO169	12/13/2021	$72.47	$107.55	$142.63	H H H H H H H D Y
Apprentice Rates:						
1st Period			$53.53	$79.15	$104.75	
2nd Period			$55.14	$81.56	$107.97	
3rd Period			$56.73	$83.94	$111.15	
4th Period			$58.31	$86.31	$114.31	
5th Period			$59.85	$88.62	$117.39	
6th Period			$63.03	$93.39	$123.75	
7th Period			$66.17	$98.10	$130.03	
8th Period			$69.32	$102.83	$136.33	
Bricklayer						
Brick Masonry, Stone Masonry, Pointing, Caulking and Cleaning	BR2-40-BSP	2/15/2022	$51.72	$67.29	$82.86	H H H H H H H D Y
Comment Make up day allowed						
Inclement weather make-up day Saturday at straight time for 8 hours, hours over 8 at time and half.						
Apprentice Rates:						
0-749 hours			$39.26	$48.60	$57.94	
750-1,499 hours			$40.82	$50.94	$61.06	
1,500- 2,249 hours			$42.38	$53.28	$64.18	
2,250-2,999 hours			$43.94	$55.62	$67.30	
3,000-3,749 hours			$45.49	$57.94	$70.40	
3,750-4,499 hours			$47.05	$60.28	$73.52	
4,500-5,249 hours			$48.61	$62.62	$76.64	
5,250 hours			$50.16	$64.95	$79.74	

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Carpenter						
Carpenter	CA-100	12/1/2021	$45.55	$58.17	$70.79	X X H H H H H D N
Comment: Make up day allowed Saturday						
Apprentice Rates:						
1st year			$37.98	$46.81	$55.65	
2nd year			$39.24	$48.71	$58.17	
3rd year			$41.76	$52.49	$63.21	
4th year			$44.29	$56.28	$68.27	
Floor Layer	CA-100FL	12/1/2021	$47.10	$60.69	$74.27	X X H H H H H D N
Comment: Make up day allowed Saturday						
Apprentice Rates:						
1st year			$38.95	$48.46	$57.97	
2nd year			$40.31	$50.50	$60.69	
3rd year			$43.02	$54.57	$66.11	
4th year			$45.74	$58.65	$71.55	
Cement Mason						
Cement Mason	BR2-40-CM	11/19/2021	$47.44	$61.03	$74.61	X X H H H H H D Y
Apprentice Rates:						
0-749 hours			$37.93	$46.76	$55.59	
750-1,499 hours			$39.29	$48.80	$58.31	
1,500-2,249 hours			$40.65	$50.84	$61.03	
2,250-2,999 hours			$42.01	$52.88	$63.75	
3,000-3,749 hours			$43.36	$54.91	$66.45	
3,750-4,499 hours			$44.72	$56.95	$69.17	
4,500 hours			$47.44	$61.03	$74.61	
Cement Mason	CE514-M	11/29/2021	$42.88	$55.60	$68.32	H H H H H H H D Y
Apprentice Rates:						
1st Year			$33.98	$42.25	$50.52	
2nd Year			$36.52	$46.06	$55.60	
3rd Year			$39.06	$49.87	$60.68	

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Drywall						
Drywall Taper and Finisher	PT-845-DF	12/9/2021	$44.64	$58.17	$71.75	H H H H H H H D N
Apprentice Rates:						
1st level			$31.06	$37.80	$44.59	
2nd level			$36.49	$45.95	$55.45	
3rd level			$41.92	$54.09	$66.31	
Electrician						
Sound and Communication Journeyman Technician	EC-275 SC	4/4/2022	$39.75	$55.49	$71.23	H H H H D D D D N
Apprentice Rates:						
1st period			$21.14	$29.81	$38.46	
2nd period			$22.71	$32.15	$41.60	
3rd period			$24.28	$34.52	$44.74	
4th period			$25.86	$36.88	$47.90	
Inside Wireman	EC-275-IW	4/4/2022	$53.90	$76.72	$99.53	H H H H H H H D Y
Comment Make up day allowed 4 consecutive 10s allowed M-ThFriday may be used as a make-up day						
Apprentice Rates:						
1st period 0-1,000 hrs			$24.09	$32.25	$40.41	
2nd period 1,001-2,000 hrs			$25.88	$34.94	$43.99	
3rd period 2,001-3,500 hrs			$27.96	$38.06	$48.15	
4th period 3,501-5,000 hours			$29.80	$40.82	$51.83	
5th period 5,001-6,500 hrs			$34.15	$47.34	$60.53	
6th period 6,501-8,000 hrs			$37.92	$53.00	$68.07	
Elevator Constructor						
Elevator Constructor Mechanic	EL-85	11/30/2021	$96.72		$152.57	D D D D D D D D Y
Comment 4 tens allowed M-TH						
Apprentice Rates:						
1st year			$68.96		$99.68	
2nd year			$74.88		$111.18	
3rd year			$77.85		$116.95	
4th year			$84.65		$129.33	

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Glazier						
Glazier 4 tens allowed on consecutive days	GL-826	12/9/2021	$49.84	$67.73	$85.62	H H H H H H H D Y
Apprentice Rates:						
1st level			$31.62	$40.40	$49.18	
2nd level			$35.12	$45.66	$56.18	
3rd Level			$40.38	$53.54	$66.70	
4th level			$45.66	$61.46	$77.26	
Heat and Frost Insulator						
Spray Insulation	AS25S	6/2/2016	$25.29	$36.51		X X X H H H H H N
Heat and Frost Insulator and Asbestos Worker						
Heat and Frost Insulators and Asbestos Workers	AS47	12/20/2021	$52.00	$68.89	$85.77	X X X H H H H D Y
Comment Make up day allowed Friday for cancelled work in a 4 10 schedule						
Apprentice Rates:						
1st year			$26.38	$33.69	$40.99	
2nd year			$30.15	$38.92	$47.68	
3rd year			$33.92	$44.15	$54.37	
4th year			$37.70	$49.39	$61.08	
5th year			$41.48	$54.63	$67.78	
Ironworker						
Reinforced Iron Work	IR-25-RF	12/16/2021	$63.59	$92.70	$121.81	H H D H D D D D N
Make up day allowed						
Apprentice Rates:						
Level 1			$47.70	$68.81	$89.91	
Level 2			$48.76	$70.40	$92.03	
Level 3			$51.49	$74.50	$97.49	
Level 4			$54.22	$78.59	$102.95	
Level 5			$56.93	$84.77	$112.62	
Level 6			$58.46	$84.95	$111.43	

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Rigging Work	IR-25-RIG	12/16/2021	$70.50	$101.32	$132.14	H H H H H H H D N
Apprentice Rates:						
Level 1& 2			$45.08	$64.21	$83.34	
Level 3			$47.97	$68.55	$89.12	
Level 4			$50.88	$72.92	$94.94	
Level 5			$53.77	$77.24	$100.72	
Level 6			$56.69	$84.41	$112.12	
Level 7			$59.57	$85.95	$112.32	
Level 8			$62.49	$90.33	$118.16	
Laborer						
Class A Laborer - all construction on buildings, pumps, well wheels, air, electric or gasoline tools, motor driven buggies, fire watch duty, working on swing scaffolds, heavy construction work, carpenter tender, cement finisher tender, heater tender & fl	l355-2-a	12/14/2021	$35.48	$46.68	$57.88	X X H H H H H D Y
Comment Make up day allowed Monday - Saturday						
Apprentice Rates:						
0 - 1,000 work hours			$29.88	$38.28	$46.68	
1,001 - 2,000 work hours			$31.00	$39.96	$48.92	
2,001 - 3,000 work hours			$32.12	$41.64	$51.16	
3,001 - 4,000 work hours			$34.36	$45.00	$55.64	
Class B Laborer - jackhammer operators, crocklayers and caisson worker in buildings.	L355-2-B	12/14/2021	$35.48	$46.68	$57.88	X X H H H H H D Y
Comment Make up day allowed Monday - Saturday						
Apprentice Rates:						
0-1,000 work hours			$29.88	$38.28	$46.68	
1,001-2,000 work hours			$31.00	$39.96	$48.92	
2,001-3,000 work hours			$32.12	$41.64	$51.16	
3,001-4,000 work hours			$34.36	$45.00	$55.64	

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Class C Laborer - top men on chimneys or towers over thirty feet in height, material mixers, portable mixer operator, plasterer tender, mason tender, and demolition burner.	L355-2-C	12/14/2021	$35.48	$46.68	$57.88	X X H H H H H D Y
Comment Make up day allowed Monday - Saturday						
Apprentice Rates:						
0-1,000 work hours			$29.88	$38.28	$46.68	
1,001-2,000 work hours			$31.00	$39.96	$48.92	
2,001-3,000 work hours			$32.12	$41.64	$51.16	
3,001-4,000 work hours			$34.36	$45.00	$55.64	
Class D Laborer - concrete specialist when no cement finishers are available; troweling, finishing, screeding, patching, cutting, curing of cast in place or precast concrete by any and all methods.	L355-2-D	12/14/2021	$40.24	$53.77	$67.30	X X H H H H H D Y
Comment Make up day allowed Monday - Saturday						
Apprentice Rates:						
0-1,000 work hours			$33.48	$43.63	$53.78	
1,001-2,000 work hours			$34.83	$45.66	$56.48	
2,001-3,000 work hours			$36.18	$47.68	$59.18	
3,001-4,000 work hours			$38.89	$51.74	$64.60	
Laborer Road Class 1: asphalt shoveler or loader, yard man, fence erector tender, dumper, joint filling, form setting, form stripper, pavement reinforcing, waterproofing, seal coating, bridge painting, sandblasting, pressure grouting, RC equipment	MITA-RZ3-C1	1/5/2022	$41.52	$55.36	$69.19	H H H H H H H D Y
Apprentice Rates:						
3,001-4,000 hours			$40.35	$53.60	$66.85	
2,001-3,000 hours			$38.01	$50.09	$62.17	
1,001-2,000 hours			$36.85	$48.35	$59.85	
0-1,000 hours			$35.68	$46.60	$57.51	

Official Rates

Classification Name	Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Laborer Road Class 2: mixer operator, air or electric tool operator, spreader, boxman, concreter paddler, power chain saw operator, paving patch truck dumper, tunnel mucker, concrete saw operator, dry pack macine and roto-mill grounds person		MITA-RZ3-C2	1/5/2022	$41.73	$55.67	$69.61	H H H H H H H D Y
	Apprentice Rates:						
	3,001-4,000 hours			$40.55	$53.90	$67.25	
	2,001-3,000 hours			$38.19	$50.36	$62.53	
	1,001-2,000 hours			$37.01	$48.59	$60.17	
	0-1,000 hours			$35.83	$46.82	$57.81	
Laborer Road Class 3: tunnel miner, finish tenders, guard rail builder, median barrier installer, earth retention barrier and wall installer, fence erector, bottom man, powder man, wagon drill and air track operator, curb and side rail setter		MITA-RZ3-C3	1/5/2022	$42.02	$56.11	$70.19	H H H H H H H D Y
	Apprentice Rates:						
	3,001-4,000 hours			$40.83	$54.32	$67.81	
	2,001-3,000 hours			$38.44	$50.74	$63.03	
	1,001-2,000 hours			$37.25	$48.95	$60.65	
	0-1,000 hours			$36.05	$47.15	$58.25	
Laborer Road Class 4: asphalt raker		MITA-RZ3-C4	1/5/2022	$42.46	$56.77	$71.07	H H H H H H H D Y
	Apprentice Rates:						
	3,001-4,000 hours			$41.24	$54.94	$68.63	
	2,001-3,000 hours			$38.81	$51.29	$63.77	
	1,001-2,000 hours			$37.60	$49.48	$61.35	
	0-1,000 hours			$36.38	$47.64	$58.91	
Laborer Road Class 5: pipe layers, oxy-gun		MITA-RZ3-C5	1/5/2022	$42.08	$56.20	$70.31	H H H H H H H D Y
	Apprentice Rates:						
	3,001-4,000 hours			$40.88	$54.40	$67.91	
	2,001-3,000 hours			$40.82	$54.30	$67.79	
	1,001-2,000 hours			$37.29	$49.01	$60.73	
	0-1,000 hours			$36.10	$47.22	$58.35	

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Laborer Road Class 6: line form setter for curb or pavement, asphalt screed checker/screw man on asphalt paving machines	MITA-RZ3-C6	1/5/2022	$42.51	$56.84	$71.17	H H H H H H H D Y
Apprentice Rates:						
3,001-4,000 hours			$41.29	$55.01	$68.73	
2,001-3,000 hours			$38.86	$51.36	$63.87	
1,001-2,000 hours			$37.64	$49.54	$61.43	
0-1,000 hours			$36.42	$47.70	$58.99	
Laborer Road Class 7: concrete specialist - including finishing and trowling, cast in place or precast by any method	MITA-RZ3-C7	1/5/2022	$45.84	$61.84	$77.83	H H H H H H H D Y
Apprentice Rates:						
3,001-4,000 hours			$44.46	$59.76	$75.07	
2,001-3,000 hours			$41.69	$55.61	$69.53	
1,001-2,000 hours			$40.30	$53.52	$66.75	
0-1,000 hours			$38.92	$51.46	$63.99	
Asbestos & Lead Abatement Laborer 4 ten hour days @ straight time allowed Monday-Saturday, must be consecutive calendar days	MLDC	1/7/2022	$46.70	$62.52	$78.33	H H H X X X X D Y
Apprentice Rates:						
Trainee 600 hours +1 year			$34.07			
Laborer - Hazardous						
Class A Laborer - performing work in conjunction with site preparation and other preliminary work prior to actual removal, handling, or containment of hazardous waste substances not requiring use of personal protective equipment required by state or feder	LHAZ-Z9-A	12/14/2021	$35.48	$50.18	$64.88	H H H H H H H D Y
Comment Make up day allowed 4 10s allowed M-Th or T-F; inclement weather makeup day Friday						
Apprentice Rates:						
0-1,000 work hours			$29.88	$41.78	$53.68	
1,001-2,000 work hours			$31.00	$43.46	$55.92	
2,001-3,000 work hours			$32.12	$45.14	$58.16	
3,001-4,000 work hours			$34.36	$48.50	$62.64	

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Class B Laborer - performing work in conjunction with the removal, handling, or containment of hazardous waste substances when the use of personal protective equipment levels "A", "B" or "C" is required.	LHAZ-Z9-B	12/14/2021	$36.48	$51.68	$66.88	H H H H H H H D Y
Comment Make up day allowed						
4 10s allowed M-Th or T-F; inclement weather makeup day Friday						
Apprentice Rates:						
0-1,000 work hours			$30.63	$42.90	$55.18	
1,001-2,000 work hours			$31.80	$44.66	$57.52	
2,001-3,000 work hours			$32.97	$46.42	$59.86	
3,001-4,000 work hours			$35.31	$49.92	$64.54	
Laborer - Landscape						
Class B1: Landscape Operatior includes air, gas, and diesel equipment operator, lawn sprinkler installer,skidsteer, mini excavators, ride and walk behind trenchers, backhoe loaders, off road dump vehicle, articulated haulers, hydroseeder, wheel loaders	LLAN-Z2-A	1/4/2022	$28.80	$39.51	$50.18	X X H X X X H D Y
Class B2: Skilled Landscape Laborer: small power tool operator, lawn sprinkler installers' tender, irrigation installers' tender material mover	LLAN-Z2-B	1/4/2022	$26.80	$36.48	$46.15	X X H X X X H D Y
Class C: landscape laborer with 90 or more calendar days worked	LLAN-Z2-C	1/7/2022	$24.66	$33.27	$41.87	H H H H H H H D N
Class D: Inexperienced landscape laborer - individual who has worked less than 90 calendar days	LLAN-Z2-D	1/7/2022	$15.54	$23.31	$31.08	H H H H H H H D N
Laborer Underground - Tunnel, Shaft & Caisson						
Class I - Tunnel, shaft and caisson laborer, dump man, shanty man, hog house tender, testing man (on gas), and watchman.	LAUCT-Z2-1	1/4/2022	$38.42	$51.00	$63.57	X X X X X X X D Y
Apprentice Rates:						
0-1,000 work hours			$32.85	$42.64	$52.43	
1,001-2,000 work hours			$33.97	$44.32	$54.67	
2,001-3,000 work hours			$35.08	$45.99	$56.89	
3,001-4,000 work hours			$37.31	$49.33	$61.35	

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Class II - Manhole, headwall, catch basin builder, bricklayer tender, mortar man, material mixer, fence erector, and guard rail builder	LAUCT-Z2-2	1/4/2022	$38.51	$51.13	$63.75	X X X X X X X D Y
Apprentice Rates:						
0-1,000 work hours			$32.92	$42.75	$52.57	
1,001-2,000 work hours			$34.04	$44.43	$54.81	
2,001-3,000 work hours			$35.16	$46.11	$57.05	
3,001-4,000 work hours			$37.39	$49.45	$61.51	
Class III - Air tool operator (jack hammer man, bush hammer man and grinding man), first bottom man, second bottom man, cage tender, car pusher, carrier man, concrete man, concrete form man, concrete repair man, cement invert laborer, cement finisher, con	LAUCT-Z2-3	1/4/2022	$38.61	$51.28	$63.95	X X X X X X X D Y
Apprentice Rates:						
0-1,000 work hours			$32.99	$42.85	$52.71	
1,001-2,000 work hours			$34.12	$44.55	$54.97	
2,001-3,000 work hours			$35.24	$46.23	$57.21	
3,001-4,000 work hours			$37.49	$49.60	$61.71	
Class IV - Tunnel, shaft and caisson mucker, bracer man, liner plate man, long haul dinky driver and well point man.	LAUCT-Z2-4	1/4/2022	$38.77	$51.52	$64.27	X X X X X X X D Y
Apprentice Rates:						
0-1,000 work hours			$33.11	$43.03	$52.95	
1,001-2,000 work hours			$34.25	$44.74	$55.23	
2,001-3,000 work hours			$35.38	$46.43	$57.49	
3,001-4,000 work hours			$37.64	$49.83	$62.01	
Class V - Tunnel, shaft and caisson miner, drill runner, keyboard operator, power knife operator, reinforced steel or mesh man (e.g. wire mesh, steel mats, dowel bars)	LAUCT-Z2-5	1/4/2022	$39.03	$51.91	$64.79	X X X X X X X D Y
Apprentice Rates:						
0-1,000 work hours			$33.31	$43.33	$53.35	
1,001-2,000 work hours			$34.45	$45.04	$55.63	
2,001-3,000 work hours			$35.60	$46.77	$57.93	
3,001-4,000 work hours			$37.89	$50.20	$62.51	

Official Rates

Classification Name	Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Class VI - Dynamite man and powder man.		LAUCT-Z2-6	1/4/2022	$39.34	$52.38	$65.41	X X X X X X X D Y
	Apprentice Rates:						
	0-1,000 work hours			$33.54	$43.67	$53.81	
	1,001-2,000 work hours			$34.70	$45.41	$56.13	
	2,001-3,000 work hours			$35.86	$47.15	$58.45	
	3,001-4,000 work hours			$38.18	$50.63	$63.09	
Class VII - Restoration laborer, seeding, sodding, planting, cutting, mulching and topsoil grading and the restoration of property such as replacing mail boxes, wood chips, planter boxes and flagstones.		LAUCT-Z2-7	1/4/2022	$31.61	$40.78	$49.95	X X X X X X X D Y
	Apprentice Rates:						
	0-1,000 work hours			$27.75	$34.99	$42.23	
	1,001-2,000 work hours			$28.52	$36.15	$43.77	
	2,001-3,000 work hours			$29.29	$37.30	$45.31	
	3,001-4,000 work hours			$30.84	$39.63	$48.41	
Laborer -Underground Open Cut, Class I							
Construction Laborer		LAUC-Z4-1	1/4/2022	$35.27	$46.28	$57.29	X X X X X X X D Y
	Apprentice Rates:						
	0-1,000 work hours			$30.52	$39.16	$47.79	
	1,001-2,000 work hours			$31.47	$40.59	$49.69	
	2,001-3,000 work hours			$32.42	$42.01	$51.59	
	3,001-4,000 work hours			$34.32	$44.86	$55.39	
Laborer -Underground Open Cut, Class II							
Mortar and material mixer, concrete form man, signal man, well point man, manhole, headwall and catch basin builder, guard rail builders, headwall, seawall, breakwall, dock builder and fence erector.		LAUC-Z4-2	1/4/2022	$35.40	$46.48	$57.55	X X X X X X X D Y
	Apprentice Rates:						
	0-1,000 work hours			$30.62	$39.31	$47.99	
	1,001-2,000 work hours			$31.57	$40.73	$49.89	
	2,001-3,000 work hours			$32.53	$42.17	$51.81	
	3,001-4,000 work hours			$34.44	$45.04	$55.63	

Official Rates

Classification Name	Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Laborer -Underground Open Cut, Class III							
Air, gasoline and electric tool operator, vibrator operator, drillers, pump man, tar kettle operator, bracers, rodder, reinforced steel or mesh man (e.g. wire mesh, steel mats, dowel bars, etc.), cement finisher, welder, pipe jacking and boring man, wagon		LAUC-Z4-3	1/4/2022	$35.51	$46.64	$57.77	X X X X X X X D Y
	Apprentice Rates:						
	0-1,000 work hours			$30.70	$39.43	$48.15	
	1,001-2,000 work hours			$31.66	$40.87	$50.07	
	2,001-3,000 work hours			$32.62	$42.31	$51.99	
	3,001-4,000 work hours			$34.55	$45.21	$55.85	
Laborer -Underground Open Cut, Class IV							
Trench or excavating grade man.		LAUC-Z4-4	1/4/2022	$35.58	$46.75	$57.91	X X X X X X X D Y
	Apprentice Rates:						
	0-1,000 work hours			$30.75	$39.51	$48.25	
	1,001-2,000 work hours			$31.72	$40.96	$50.19	
	2,001-3,000 work hours			$32.68	$42.40	$52.11	
	3,001-4,000 work hours			$34.61	$45.29	$55.97	
Laborer -Underground Open Cut, Class V							
Pipe Layer (including crock, metal pipe, multiplate or other conduits)		LAUC-Z4-5	1/4/2022	$35.70	$46.93	$58.15	X X X X X X X D Y
	Apprentice Rates:						
	0-1,000 work hours			$30.84	$39.64	$48.43	
	1,001-2,000 work hours			$31.81	$41.09	$50.37	
	2,001-3,000 work hours			$32.78	$42.55	$52.31	
	3,001-4,000 work hours			$34.73	$45.47	$56.21	

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Laborer -Underground Open Cut, Class VI						
Grouting man, top man assistant, audio visual television operations and all other operations in connection with closed circuit television inspection, pipe cleaning and pipe relining work & the installation and repair of water service pipe and appurtenance	LAUC-Z4-6	1/4/2022	$32.92	$42.76	$52.59	X X X X X X X D Y
Apprentice Rates:						
0-1,000 work hours			$28.76	$36.52	$44.27	
1,001-2,000 work hours			$29.59	$37.77	$45.93	
2,001-3,000 work hours			$30.42	$39.01	$47.59	
3,001-4,000 work hours			$32.09	$41.51	$50.93	
Laborer -Underground Open Cut, Class VII						
Restoration laborer, seeding, sodding, planting, cutting, mulching and topsoil grading and the restoration of property such as replacing mail boxes, wood chips, planter boxes, flagstones etc.	LAUC-Z4-7	1/4/2022	$31.26	$40.27	$49.27	X X X X X X X D Y
Apprentice Rates:						
0-1,000 work hours			$27.51	$34.65	$41.77	
1,001-2,000 work hours			$28.26	$35.77	$43.27	
2,001-3,000 work hours			$29.01	$36.89	$44.77	
3,001-4,000 work hours			$30.51	$39.15	$47.77	
Operating Engineer						
Compressor or Welding MachineFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-AC	12/10/2021	$52.42	$66.13	$79.83	X X H H D D D D Y
Comment Make up day allowed Friday						
Forklift or Straight MastFour 10 hour days may be scheduled M-Th or T-F. Work not performed due to weather on M-Th may be scheduled on Friday	EN-F	12/10/2021	$53.87	$68.30	$82.73	X X H H D D D D Y
Comment Make up day allowed Friday						
Fireman or Oiler Four 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-FO	12/10/2021	$51.39	$64.58	$77.77	X X H H D D D D Y
Comment Make up day allowed Friday						

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Lull or Extend-a-Boom ForkliftFour 10 hour days may be scheduled M-Th or T-F. Work not performed due to weather on M-Th may be scheduled on Friday Comment: Make up day allowed Friday	en-l	12/10/2021	$59.73	$77.09	$94.45	X X H H D D D D Y
Crane with main boom & jib 120' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Worked not performed due to weather, Monday-Thursday may be scheuled Friday Comment: Make up day allowed Friday	en-os120	12/10/2021	$63.27	$82.40	$101.53	X X H H D D D D Y
Crane w/ main Boom & Jib 220' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday. Comment: Make up day allowed Friday	EN-OSA	12/10/2021	$64.38	$84.07	$103.75	X X H H D D D D Y
Crane w/ main Boom & Jib 300' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work unabled to be performed due to weather, Monday-Thursday may be scheduled on Friday. Comment: Make up day allowed Friday	EN-OSA3	12/10/2021	$65.89	$86.33	$106.77	X X H H D D D D Y
Crane w/ main Boom & Jib 400' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday. Comment: Make up day allowed Friday	EN-OSA4	12/10/2021	$67.39	$88.58	$109.77	X X H H D D D D Y
Crane with main boom and jib 140' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work unabled to be performed due to weather, Monday-Thursday may be scheduled on Friday. Comment: Make up day allowed Friday	EN-OSB	12/10/2021	$64.09	$83.63	$103.17	X X H H D D D D Y

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Regular Crane Operator, Job Mechanic, Concrete Pump with BoomFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-RC	12/10/2021	$62.41	$81.11	$99.81	X X H H D D D D Y
Comment: Make up day allowed Friday						
Apprentice Rates:						
0-999 hours			$51.13	$64.18	$77.22	
1,000-1,999 hours			$52.99	$66.96	$80.94	
2,000-2,999 hours			$54.86	$69.77	$84.68	
3,000-3,999 hours			$56.72	$72.56	$88.40	
4,000-4,999 hours			$58.59	$75.36	$92.14	
5,000-5,999 hours			$60.44	$78.15	$95.84	
Regular Engineer, Hydro Excavator & Remote Controlled Concrete BreakerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	en-re	12/10/2021	$61.44	$79.66	$97.87	X X H H D D D D Y
Comment: Make up day allowed Friday						
Operating Engineer - Marine Construction						
Diver/Wet Tender/Tender/Rov Pilot/Rov Tender	GLF D	12/16/2021	$52.81	$78.57	$104.32	H H H H H H H D N
Diver/Wet Tender, Engineer (hydraulic dredge)	GLF-1	1/7/2022	$78.97	$102.47	$125.97	X X H H H H H D Y
Make up day allowed						
Subdivision of county: all Great Lakes, islands therein, & connecting & tributary waters						
Crane/Backhoe Operator, 70 ton or over Tug Operator, Mechanic/Welder, Assistant Engineer (hydraulic dredge), Leverman (hydraulic dredge), Diver Tender	GLF-2	1/7/2022	$77.47	$100.22	$122.97	X X H H H H H D Y
Make up day allowed						
Subdivision of county: All Great Lakes, islands therein, & connecting & tributary waters						
Friction, Lattice Boom or Crane License Certification30	GLF-2B	1/7/2022	$78.97	$102.47	$125.97	X X H H H H H D Y
Make up day allowed						
Subdivision of county: All Great Lakes, islands, therein, & connecting & tributary waters						
Deck Equipment Operator, Machineryman, Maintenance of Crane (over 50 ton capacity) or Backhoe (115,000 lbs or more), Tug/Launch Operator, Loader, Dozer on Barge, Deck Machinery	GLF-3	1/7/2022	$72.92	$93.40	$113.87	X X H H H H H D Y
Make up day allowed						
Subdivision of county: All Great Lakes, islands therein, & connecting & tributary waters						

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Deck Equipment Operator, (Machineryman/Fireman), (4 equipment units or more), Off Road Trucks, Deck Hand, Tug Engineer, & Crane Maintenance 50 ton capacity and under or Backhoe 115,000 lbs or less, Assistant Tug Operator	GLF-4	1/7/2022	$66.72	$84.10	$101.47	X X H H H H H D Y
Make up day allowed						
Subdivision of county All Great Lakes, islands therein, & connecting & tributary waters						
Operating Engineer Steel Work						
Forklift, 1 Drum Hoist	EN-324-ef	12/9/2021	$59.30	$76.43	$93.56	H H D H H H D D Y
Comment Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 120' boom or longer	EN-324-SW120	12/10/2021	$68.61	$90.40	$112.18	H H D H H H D D Y
Comment Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 120' boom or longer w/ Oiler	EN-324-SW120-O	12/10/2021	$69.61	$91.90	$114.18	H H D H H H D D Y
Comment Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 140' boom or longer	EN-324-SW140	12/10/2021	$69.79	$92.17	$114.54	H H D H H H D D Y
Comment Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 140' boom or longer W/ Oiler	EN-324-SW140-O	12/10/2021	$70.79	$93.67	$116.54	H H D H H H D D Y
Comment Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Boom & Jib 220' or longer	EN-324-SW220	12/10/2021	$70.06	$92.57	$115.08	H H D H H H D D Y
Comment Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 220' boom or longer w/ Oiler	EN-324-SW220-O	12/10/2021	$71.06	$94.07	$117.08	H H D H H H D D Y
Comment Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Boom & Jib 300' or longer	EN-324-SW300	12/10/2021	$71.56	$94.82	$118.08	H H D H H H D D Y
Comment Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 300' boom or longer w/ Oiler	EN-324-SW300-O	12/10/2021	$72.56	$93.20	$113.84	H H D H H H D D Y
Comment Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						

Official Rates

Classification Name / Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Boom & Jib 400' or longer	EN-324-SW400	12/10/2021	$73.06	$97.07	$121.08	H H D H H H D D Y
Comment: Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 400' boom or longer w/ Oiler	EN-324-SW400-O	12/10/2021	$74.06	$98.57	$123.08	H H D H H H D D Y
Comment: Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane Operator, Job Mechanic, 3 Drum Hoist & Excavator	EN-324-SWCO	12/10/2021	$68.25	$89.86	$111.46	H H D H H H D D Y
Comment: Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Apprentice Rates:						
0-999 hours			$49.22	$62.96	$76.70	
1,000-1,999 hours			$51.18	$65.90	$80.62	
2,000-2,999 hours			$53.15	$68.85	$84.56	
3,000-3,999 hours			$55.11	$71.80	$88.48	
4,000-4,999 hours			$57.07	$74.74	$92.40	
5,000 hours			$59.04	$77.69	$96.34	
Crane Operator w/ Oiler	EN-324-SWCO-O	12/10/2021	$69.25	$91.36	$113.46	H H D H H H D D Y
Comment: Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Compressor or Welder Operator	EN-324-SWCW	12/10/2021	$37.03	$49.48	$61.92	H H D H H H D D Y
Comment: Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Hoisting Operator, 2 Drum Hoist, & Rubber Tire Backhoe	EN-324-SWHO	12/10/2021	$67.61	$88.90	$110.18	H H D H H H D D Y
Comment: Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Oiler	EN-324-SWO	12/10/2021	$53.42	$67.61	$81.80	H H D H H H D D Y
Comment: Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Tower Crane & Derrick where work is 50' or more	EN-324-SWTD50	12/10/2021	$69.34	$91.49	$113.64	H H D H H H D D Y
Comment: Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						
Tower Crane & Derrick 50' or more w/ Oiler	EN-324-SWTD50-O	12/10/2021	$70.34	$92.99	$115.64	H H D H H H D D Y
Comment: Make up day allowed 4 10s allowed M-Th with Friday makeup day because of bad weather						

Official Rates

Classification Name	Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Operating Engineer Underground							
Class I Equipment - Backfiller Tamper, Backhoe, Batch Plant Operator, Clamshell, Concrete Paver 2 drums or larger, Conveyor Loader Euclid type, Crane (crawler, truck type or pile driving), Dozer, Dragline, Elevating Grader, endloader, gradall, grader, hyd		EN-324A2-UC1	12/10/2021	$60.93	$78.89	$96.85	H H H H H H H D Y
	Apprentice Rates:						
	0-999 hours			$49.19	$61.74	$74.29	
	1,000-1,999 hours			$50.99	$64.44	$77.89	
	2,000-2,999 hours			$52.78	$67.12	$81.47	
	3,000-3,999 hours			$54.58	$69.82	$85.07	
	4,000-4,999 hours			$56.37	$72.51	$88.65	
	5,000-5,999 hours			$58.16	$75.19	$92.23	
Class II Equipment - Boom Truck, Crusher, Hoist, Pump 6 inch discharge or larger, side boom tractor, Tractor (pneu-tired other than backhoe or front end loader), Trencher 8 ft. digging capcity and smaller, Vac Truck		EN-324A2-UC2	12/10/2021	$56.04	$71.56	$87.07	H H H H H H H D Y
Class III Equipment - Air Compressors 600 cfm or larger, Air Compressors 2 or more less than 600 dfm, Boom Truck non-swinging non-powered type boom, Concrete Breaker self-propelled or truck mounted, Concrete paver 1 drum 1/2 yd. or larger, Elevator other		EN-324A2-UC3	12/10/2021	$55.54	$70.81	$86.07	H H H H H H H D Y
Class IV Equipment - Boiler, Concrete Saw 40 hp or over, curing machine self propelled, end dumps, extend a boom forklift, farm tractor with attachment, finishing machine concrete, firemen, hydraulic pipe pushing machine, mulching equipment, oiler, pumps		EN-324A2-UC4	12/10/2021	$55.26	$70.39	$85.51	H H H H H H H D Y
Painter							
Painter A 4-10s workweek allowed Monday-Thursday.		PT-845-BR	1/7/2022	$40.09	$52.29	$64.49	H H H H H H H D Y
	Apprentice Rates:						
	1st level			$27.89	$33.99	$40.09	
	2nd level			$30.33	$37.65	$44.97	
	3rd level			$33.99	$43.14	$52.29	
	4th level			$37.65	$48.63	$59.61	

Official Rates

Classification Name	Classification Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Pipe and Manhole Rehab							
General Laborer for rehab work or normal cleaning and cctv work-top man, scaffold man, CCTV assistant, jetter-vac assistant		TM247	4/17/2015	$28.20	$38.20		H H H H H H H H N
Tap cutter/CCTV Tech/Grout Equipment Operator: unit driver and operator of CCTV; grouting equipment and tap cutting equipment		TM247-2	4/17/2015	$32.70	$44.95		H H H H H H H H N
CCTV Technician/Combo Unit Operator: unit driver and operator of cctv unit or combo unit in connection with normal cleaning and televising work		TM247-3	4/17/2015	$31.45	$43.07		H H H H H H H H N
Boiler Operator: unit driver and operator of steam/water heater units and all ancillary equipment associated		TM247-4	4/17/2015	$33.20	$45.70		H H H H H H H H N
Combo Unit driver & Jetter-Vac Operator		TM247-5	4/17/2015	$33.20	$45.70		H H H H H H H H N
Pipe Bursting & Slip-lining Equipment Operator		TM247-6	4/17/2015	$34.20	$47.20		H H H H H H H H N
Plasterer							
Plasterer		BR2-40-P	11/19/2021	$51.72	$67.29	$82.86	H H H H H H H D Y
	Apprentice Rates:						
	0-749 hours			$40.82	$50.94	$61.06	
	750-1,499 hours			$42.38	$53.28	$64.18	
	1,500-2,249 hours			$43.94	$55.62	$67.30	
	2,250-2,999 hours			$45.49	$57.94	$70.40	
	3,000-3,749 hours			$47.05	$60.28	$73.52	
	3,750-4,499 hours			$48.61	$62.62	$76.64	
	4,500 hours			$51.72	$67.29	$82.86	

Official Rates

Classification Name	Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Plumber, Pipefitter, Welder, HVAC & Refrigeration							
Plumber, Pipefitter, Welder, HVAC &Refrigeration 4 tens may be worked M-Thursday or Tuesday-F @ the straight time rate.4 tens may also be worked M-F on a holiday week only.		PL-174-PP	1/7/2022	$53.63	$75.43	$97.22	H H D H H H D D Y
	Apprentice Rates:						
	1st year			$26.15	$34.20	$42.26	
	2nd year			$33.06	$44.57	$56.08	
	3rd year			$35.15	$47.71	$60.26	
	4th year			$39.33	$53.97	$68.62	
	5th year			$43.51	$60.25	$76.98	
Roofer							
Commercial Roofer		RO-70-Z4	12/1/2021	$35.56	$45.86	$56.16	X X X X X X X D N
	Apprentice Rates:						
	1st Class			$28.20	$35.21	$42.21	
	2nd Class			$29.35	$36.87	$44.39	
	3rd Class			$30.30	$38.23	$46.16	
	4th Class			$32.10	$40.85	$49.61	
	5th Class			$33.01	$42.18	$51.34	
	6th Class			$33.88	$43.35	$52.83	
	7th Class			$34.71	$44.60	$54.49	
Sewer Relining							
Class I-Operator of audio visual CCTV system including remote in-ground cutter and other equipment used in conjunction with CCTV system.		SR-I	12/10/2021	$49.71	$67.42	$85.13	H H H H H H H D N
	Apprentice Rates:						
	0-6 months			$39.05	$51.43	$63.81	
	6-12 months			$42.83	$57.10	$71.37	
Class II-Operator of hot water heaters and circulation system; water jetters; and vacuum and mechanical debris removal systems and those assisting.		SR-II	12/10/2021	$47.67	$64.36	$81.05	H H H H H H H D N

Official Rates

Classification Name	Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Sheet Metal Worker							
Sheet Metal Worker	4 10s allowed as consecutive days, M-Th or T-F	SHM-7-2	1/14/2022	$49.87	$67.01	$84.14	H H H H D D D D Y
Comment	Make up day allowed						
	For work missed due to inclement weather, make up hours to be paid at regular rate of pay.						
	Apprentice Rates:						
	1st year			$25.71	$34.28	$42.85	
	2nd year			$29.13	$39.41	$49.69	
	3rd year			$39.59	$51.58	$63.58	
	4th year			$43.02	$56.73	$70.44	
Sprinkler Fitter							
Sprinkler Fitter		SP 669	11/16/2021	$60.34	$78.45	$96.56	H H H H H H H D Y
	Make up day allowed						
	Apprentice Rates:						
	Class 1			$24.57	$32.72	$40.87	
	Class 2			$26.38	$35.43	$44.49	
	Class 3			$39.14	$49.10	$59.06	
	Class 4			$40.95	$51.82	$62.68	
	Class 5			$43.01	$54.78	$66.55	
	Class 6			$44.82	$57.49	$70.17	
	Class 7			$46.63	$60.21	$73.79	
	Class 8			$48.45	$62.94	$77.43	
	Class 9			$50.26	$65.65	$81.05	
	Class 10			$52.07	$68.37	$84.67	
Tile, Terrazzo and Mosaic Finisher							
Tile, Terrazzo and Mosaic Finisher		BR2-TF	12/3/2021	$42.34	$54.17	$65.99	H H H H H H H D N
	Apprentice Rates:						
	1st Period			$35.25	$43.53	$51.81	
	2nd Period			$36.43	$45.30	$54.17	
	3rd Period			$37.61	$47.07	$56.53	
	4th Period			$38.79	$48.84	$58.89	
	5th Period			$39.97	$50.61	$61.25	
	6th Period			$41.16	$52.39	$63.63	

Official Rates

Classification Name	Description	Classification Number	Last Updated	Straight Hourly	Time and a Half	Double Time	Overtime Provision
Tile, Terrazzo and Mosaic Setters							
Tile, Terrazzo and Mosaic Setters		BR2-Tile	12/3/2021	$48.48	$62.11	$75.73	H H H H H H H D N
	Apprentice Rates:						
	1st Period			$40.31	$49.85	$59.39	
	2nd Period			$41.67	$51.89	$62.11	
	3rd Period			$43.03	$53.93	$64.83	
	4th Period			$44.39	$55.97	$67.55	
	5th Period			$45.75	$58.01	$70.27	
	6th Period			$47.12	$60.07	$73.01	
Truck Driver							
of all trucks of 8 cubic yd capacity or over		TM-RB2	1/12/2022	$44.10	$48.81		H H H H H H H H Y
of all trucks of 8 cubic yard capacity or less (except dump trucks of 8 cubic yard capacity or over, tandem axle trucks, transit mix and semis, euclid type equipment, double bottoms and low boys)		TM-RB2A	6/7/2016	$44.00	$48.66		H H H H H H H H Y
on euclid type equipment		TM-RB2B	6/7/2016	$44.25	$49.04		H H H H H H H H Y

Official Rates

ATTACHMENT F

Quarterly Construction Wage Interview Report

for Federally Funded Projects

Attention: _____
Project Manager, GFIAA Engineering
Gerald R. Ford International Airport Authority (GFIAA)

Project Number: C - _____

Project Name: _____

Quarter Covered (i.e. Q1 2023): _____

Prime Contractor on Project: _____

As part of our contracted responsibilities for Construction Administration, we have conducted Labor Standards Interviews using General Services Administration (GSA) form SF1445. All quarterly interviews for the above project were conducted on-site using the following criteria:

- One (1) interview with an employee from the prime contractor and all subcontractors working on-site within the first two (2) weeks of starting construction and second round of on-site interviews closer to substantial completion while workers are still on site.
- If the above does not apply, conduct one (1) interview for one (1) person from every contractor and subcontractor company working on-site sometime during the applicable quarter.
- Whenever a new subcontractor begins work on the project.
- Additional interviews when issues or discrepancies arise and should be targeted at the contractor in question.

Check One:

☐ Interview responses have shown compliance with Department of Labor wage rate requirements. No further investigation is necessary.

☐ Interview responses indicate potential non-compliance with Department of Labor wage rate requirements. Further investigation is necessary.

Please attach all completed GSA SF1445 forms

_____
Signature

_____
Name

_____
Company

_____
Date

LABOR STANDARDS INTERVIEW

CONTRACT NUMBER	EMPLOYEE INFORMATION		
	LAST NAME	FIRST NAME	MI
NAME OF PRIME CONTRACTOR			
	STREET ADDRESS		
NAME OF EMPLOYER			
	CITY	STATE	ZIP CODE
SUPERVISOR'S NAME			
LAST NAME / FIRST NAME / MI	WORK CLASSIFICATION	WAGE RATE	

ACTION	CHECK BELOW YES	NO
Do you work over 8 hours per day?		
Do you work over 40 hours per week?		
Are you paid at least time and a half for overtime hours?		
Are you receiving any cash payments for fringe benefits required by the posted wage determination decision?		

WHAT DEDUCTIONS OTHER THAN TAXES AND SOCIAL SECURITY ARE MADE FROM YOUR PAY?

	TOOLS YOU USE	
HOW MANY HOURS DID YOU WORK ON YOUR LAST WORK DAY BEFORE THIS INTERVIEW?		
DATE OF LAST WORK DAY BEFORE INTERVIEW *(YYMMDD)*		
DATE YOU BEGAN WORK ON THIS PROJECT *(YYMMDD)*		

THE ABOVE IS CORRECT TO THE BEST OF MY KNOWLEDGE

EMPLOYEE'S SIGNATURE	DATE *(YYMMDD)*

INTERVIEWER	SIGNATURE	TYPED OR PRINTED NAME	DATE *(YYMMDD)*

INTERVIEWER'S COMMENTS

WORK EMPLOYEE WAS DOING WHEN INTERVIEWED	ACTION *(If explanation is needed, use comments section)*	YES	NO
	IS EMPLOYEE PROPERLY CLASSIFIED AND PAID?		
	ARE WAGE RATES AND POSTERS DISPLAYED?		

FOR USE BY PAYROLL CHECKER

IS ABOVE INFORMATION IN AGREEMENT WITH PAYROLL DATA?

☐ YES ☐ NO

COMMENTS

CHECKER

LAST NAME	FIRST NAME	MI	JOB TITLE

SIGNATURE	DATE *(YYMMDD)*

D. Mechanical and Plumbing Engineer:

1. John Hatsios, P.E.
2. Responsible for Divisions 20-23

E. Electrical Engineer:

1. Eric Graettinger, P.E.
2. Responsible for Division 26, 28

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DOCUMENT 00 11 13
ADVERTISEMENT FOR BIDS

1.1 PROJECT INFORMATION

A. Project Identification: Gerald R. Ford International Airport – Snow Equipment Removal Building Expansion.

1. Project Location: 4800 Patterson Avenue, Grand Rapids, Michigan 49512.

B. Owner: Gerald R. Ford International Airport Authority (GFIAA).

1. Owner's Representative: Jeff Berghage, Facility Design and Construction Project Manager

C. Architect: C&S Companies

1. Architect's Representative: Amy Sonbuchner – asonbuchner@cscos.com

2. Please contact the Architect for all project related inquiries. GFIAA reserves the right to publish and respond to an inquiry, respond directly to the inquirer without publishing, or not respond to the inquiry at its sole discretion.

A. Project Description: Snow Equipment Removal Building Expansion totaling approximately 65,000sf. The expansion will be constructed on a previously developed site, located on the secure (airside) of the airport perimeter secure fence.

B. Construction Contract: Bids will be received as a lump sum under a General Contractor for all trades.

1.2 BID SUBMITTAL AND OPENING

A. Refer to "Request for Bids from GFIAA."

1.3 BID SECURITY

A. Bid security shall be submitted with each bid in the amount of 5 percent of the bid amount. No bids may be withdrawn for a period of 60 days after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

1.4 PREBID MEETING

A. Refer to "Request for Bids from GFIAA."

1.5 DOCUMENTS

A. Refer to "Request for Bids from GFIAA."

1.6 TIME OF COMPLETION

A. Successful bidder shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time; refer to Section 00 31 13 Preliminary Schedules.

1.7 BIDDER'S QUALIFICATIONS

A. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work. A Performance Bond, separate Labor and Material Payment Bond, and Insurance in a form acceptable to Owner will be required of the successful Bidder.

END OF DOCUMENT 00 11 13

DOCUMENT 00 21 13
INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

A. AIA Document A701, "Instructions to Bidders," is hereby incorporated into the Procurement and Contracting Requirements by reference.

1. A copy of AIA Document A701, "Instructions to Bidders," is bound in this Project Manual.

1.2 INSTRUCTIONS TO BIDDERS, GENERAL:

A. Information submitted in this solicitation is subject to the Michigan Freedom of Information Act (FOIA) and may not be held in confidence after the Respondent's submission is opened. A submission will be available for review after staff has evaluated it, or fifteen (15) business days after the opening date, whichever comes first. GFIAA cannot assure that any of the information submitted as part of or peripheral to the Respondent's submission will be kept confidential. Any Respondent submission language as confidential is considered automatically invalid and void. GFIAA is subject to FOIA which prohibits it from concealing information on or associated with responses, successful or unsuccessful, once they are opened.

B. Costs for Responding to this RFP – GFIAA will not pay for any information requested in the RFP or any cost incurred in submitting proposals, responding to additional questions, or participating in the interview process.

C. Rejection of Proposals – GFIAA reserves the right to reject any or all proposals in whole or in part and to waive irregularities in proposals received.

D. Insurance requirements are posted on the Documents and Forms page of the GFIAA website within the Purchasing Terms and Conditions document

E. Evaluation, Status Updates, and Award Notification – GFIAA reserves the right to request additional information it may deem necessary after the submissions are received. As part of the evaluation process, Respondents may be requested to make an oral presentation, at the Respondent's expense, to an evaluation committee. Staff to be assigned to this project must participate in this presentation unless otherwise waived by GFIAA. The presentation will be followed by a question and answer session.

F. Any errors, omissions or discrepancies in the RFP discovered by a prospective Respondent shall be brought to the attention of the GFIAA Purchasing Division as soon as possible after discovery. Further, the Respondent shall not be allowed to take advantage of error, omissions or discrepancies in the specifications.

G. GFIAA, at its sole discretion, reserves the right to award to the Respondent whose response is deemed most advantageous to GFIAA. GFIAA, at its sole discretion, shall select the most responsive and responsible Respondent and evaluate all responses

based on the requirements and criterion set forth in this solicitation while reserving the right to weigh specifications and other factors in the award.

H. Proposer's Communications with Airport Officials and Employees Restricted – GFIAA staff will not be available for project related information, except as identified herein.

I. Non-Discrimination - The Bidder shall not discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions or privileges of employment, or a matter directly or indirectly related to employment, because of race, color, religion, national origin, age, sex, height, weight, marital status, or disability that is unrelated to the individual's ability to perform the duties of a particular job or position. The Bidder shall observe and comply with all applicable federal, state and local laws, ordinances, rules and regulations which shall be deemed to include, but not be limited to, the Elliott-Larsen Civil Rights Act and the Persons with Disabilities Civil Rights Act.

J. Signature - Each proposal must be signed by a person authorized to sign contracts on the behalf of the firm. The name of the person signing must be followed by title.

K. Taxes - GFIAA is tax exempt. A copy of the Tax Certificate of Exemption shall be available to the successful bidder.

L. By submitting, the Respondent certifies that the response has not been made or prepared in collusion with any other Respondent and the prices, terms or conditions thereof have not been communicated by or on behalf of the Respondent to any other Respondent prior to the official opening of this request. This certification may be treated for all purposes as if it were a sworn statement made under oath, subject to the penalties for perjury. Moreover, it is made subject to the provisions of 18 U.S.C. Section 1001, relating to the making of false statements.

M. Sales and Marketing material beyond the scope of this request will not be used to determine the award and is not desired. Each submission should be simply and economically prepared, providing a concise description of the Respondent's ability to perform the product or services requested. Emphasis should be on completeness and clarity of content.

N. Submissions may be withdrawn by written request only if the request is received on or before the opening date and time.

O. Submissions not meeting these conditions may be deemed non-responsive.

P. GFIAA is not liable for any costs incurred by any prospective Respondent prior to the awarding of a contract, including any costs incurred in addressing this solicitation.

1.3 DBE PARTICIPATION REQUIREMENT

In order to increase DBE participation on GFIAA locally funded contracts, for any project with an assigned DBE contract requirement for DBE participation, the Contractor is required to select a portion of work available on the project for DBE participation. The Contractor may use DBE subcontractors, suppliers, manufacturers, or professional service providers to fulfill the assigned DBE contract goal as long as the DBE is certified in the types of work selected.

1. The assigned DBE contract requirement on this project is 3% of the total construction bid amount.

2. GFIAA recognizes DBE certification from the following agencies:
   a. Michigan Unified Certification Program (MUCP)
   b. The City of Grand Rapids.
   c. Michigan Minority Supplier Development Council
   d. Michigan Small Business Association

3. DBE Supplier Directory:

   MUCP (Michigan Unified Certification Program) Certified DBE Directory
   City of Grand Rapids Micro-Local Business Directory
   GRABB (Grand Rapids Area Black Business Directory)
   Great Lakes Women's Business Council
   SBA 8(a) Minority-Owned and Woman-Owned Business Directory
   VetBizCentral
   VeteranOwnedBusiness.com (Veteran Business Directory)
   West Michigan Hispanic Chamber of Commerce Business Directory
   West Michigan Minority and Woman-Owned 2013 Business Directory
   West Michigan Chamber Coalition

4. Bidder shall submit a written assurance of meeting the above requirement and shall include names of DBE subcontractors, work to be performed and dollar values of each proposed DBE subcontract. This information shall be submitted with the Bid Form.

END OF DOCUMENT 00 21 13

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DRAFT

AIA® Document A701™ – 2018

Instructions to Bidders

for the following Project:

Snow Equipment Removal Building Expansion
4800 Patterson Avenue
Grand Rapids, MI 49512

THE OWNER:

Gerald R. Ford International Airport Authority
5500 44th Street Southeast
Grand Rapids, MI 49512

THE ARCHITECT:

C&S Companies
38777 Six Mile Road
Suite 202
Livonia, MI 48152

TABLE OF ARTICLES

1 DEFINITIONS

2 BIDDER'S REPRESENTATIONS

3 BIDDING DOCUMENTS

4 BIDDING PROCEDURES

5 CONSIDERATION OF BIDS

6 POST-BID INFORMATION

7 PERFORMANCE BOND AND PAYMENT BOND

8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

FEDERAL, STATE, AND LOCAL LAWS MAY IMPOSE REQUIREMENTS ON PUBLIC PROCUREMENT CONTRACTS. CONSULT LOCAL AUTHORITIES OR AN ATTORNEY TO VERIFY REQUIREMENTS APPLICABLE TO THIS PROCUREMENT BEFORE COMPLETING THIS FORM.

It is intended that AIA Document G612™–2017, Owner's Instructions to the Architect, Parts A and B will be completed prior to using this document.

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ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the Proposed Contract Documents. The Bidding Requirements consist of the advertisement or invitation to bid, Instructions to Bidders, supplementary instructions to bidders, the bid form, and any other bidding forms. The Proposed Contract Documents consist of the unexecuted form of Agreement between the Owner and Contractor and that Agreement's Exhibits, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda, and all other documents enumerated in Article 8 of these Instructions.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, or in other Proposed Contract Documents apply to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect, which, by additions, deletions, clarifications, or corrections, modify or interpret the Bidding Documents.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents, to which Work may be added or deleted by sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from, or that does not change, the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 By submitting a Bid, the Bidder represents that:

- **.1** the Bidder has read and understands the Bidding Documents;
- **.2** The Bidder is a properly licensed Contractor according to the laws and regulations of the State of Michigan and meets qualifications indicated in the Procurement and Contracting Documents;
- **.3** the Bid complies with the Bidding Documents;
- **.4** the Bidder has visited the site, become familiar with local conditions under which the Work is to be performed, and has correlated the Bidder's observations with the requirements of the Proposed Contract Documents;
- **.5** the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception;
- **.6** The Bidder has investigated all required fees, permits, and regulatory requirements of authorities having jurisdiction and has properly included in the submitted bid the cost of such fees, permits, and requirements not otherwise indicated as provided by Owner.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 Distribution

§ 3.1.1 Bidders shall obtain complete Bidding Documents, from the issuing office designated in the advertisement or invitation to bid, for the deposit sum, if any, stated therein.

§ 3.1.2 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the advertisement or invitation to bid, or in supplementary instructions to bidders.

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User Notes: (1700949058)

§ 3.1.3 Bidders shall use complete Bidding Documents in preparing Bids. Neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete Bidding Documents.

§ 3.1.4 The Bidding Documents will be available for the sole purpose of obtaining Bids on the Work. No license or grant of use is conferred by distribution of the Bidding Documents.

§ 3.2 Modification or Interpretation of Bidding Documents

§ 3.2.1 The Bidder shall carefully study the Bidding Documents, shall examine the site and local conditions, and shall notify the Architect of errors, inconsistencies, or ambiguities discovered and request clarification or interpretation pursuant to Section 3.2.2.

§ 3.2.2 Requests for clarification or interpretation of the Bidding Documents shall be submitted by the Bidder in writing and shall be received by the Architect at least three business days prior to the date for receipt of Bids.

§ 3.2.3 Modifications and interpretations of the Bidding Documents shall be made by Addendum. Modifications and interpretations of the Bidding Documents made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3 Substitutions

§ 3.3.1 The materials, products, and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution.

§ 3.3.2 Substitution Process

§ 3.3.2.1 Written requests for substitutions shall be received by the Architect at least ten days prior to the date for receipt of Bids. Requests shall be submitted in the same manner as that established for submitting clarifications and interpretations in Section 3.2.2.

§ 3.3.2.2 Bidders shall submit substitution requests on a Substitution Request Form if one is provided in the Bidding Documents.

§ 3.3.2.3 If a Substitution Request Form is not provided, requests shall include (1) the name of the material or equipment specified in the Bidding Documents; (2) the reason for the requested substitution; (3) a complete description of the proposed substitution including the name of the material or equipment proposed as the substitute, performance and test data, and relevant drawings; and (4) any other information necessary for an evaluation. The request shall include a statement setting forth changes in other materials, equipment, or other portions of the Work, including changes in the work of other contracts or the impact on any Project Certifications (such as LEED), that will result from incorporation of the proposed substitution.

§ 3.3.3 The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

§ 3.3.4 If the Architect approves a proposed substitution prior to receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding, and Bidders shall not rely upon them.

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§ 3.3.5 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 3.4 Addenda

§ 3.4.1 Addenda will be transmitted to Bidders known by the issuing office to have received complete Bidding Documents.

§ 3.4.2 Prior to submitting a Bid, each Bidder shall ascertain that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 Preparation of Bids

§ 4.1.1 Bids shall be submitted on the forms included with or identified in the Bidding Documents.

§ 4.1.2 All blanks on the bid form shall be legibly executed. Paper bid forms shall be executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and numbers, unless noted otherwise on the bid form. In case of discrepancy, the amount entered in words shall govern.

§ 4.1.4 Edits to entries made on paper bid forms must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change" or as required by the bid form.

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall neither make additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name and legal status of the Bidder. As part of the documentation submitted with the Bid, the Bidder shall provide evidence of its legal authority to perform the Work in the jurisdiction where the Project is located. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further name the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached, certifying the agent's authority to bind the Bidder.

§ 4.1.8 A Bidder shall incur all costs associated with the preparation of its Bid.

§ 4.1.9 Bids shall be submitted with a statement of qualifications per AIA Document A305 Contractor's Qualification Statement.

§ 4.2 Bid Security

§ 4.2.1 Each Bid shall be accompanied by a bid security.

§ 4.2.2 The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and shall, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a

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penalty. In the event the Owner fails to comply with Section 6.2, the amount of the bid security shall not be forfeited to the Owner.

§ 4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until (a) the Contract has been executed and bonds, if required, have been furnished; (b) the specified time has elapsed so that Bids may be withdrawn; or (c) all Bids have been rejected. However, if no Contract has been awarded or a Bidder has not been notified of the acceptance of its Bid, a Bidder may, beginning 60 days after the opening of Bids, withdraw its Bid and request the return of its bid security.

§ 4.3 Submission of Bids

§ 4.3.1 A Bidder shall submit its Bid as indicated in the Advertisement for Bids.

§ 4.3.2 Paper copies of the Bid, the bid security, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address, and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.3 Bids shall be submitted by the date and time and at the place indicated in the invitation to bid. Bids submitted after the date and time for receipt of Bids, or at an incorrect place, will not be accepted.

§ 4.3.4 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.5 A Bid submitted by any method other than as provided in this Section 4.3 will not be accepted.

§ 4.4 Modification or Withdrawal of Bid

§ 4.4.1 Prior to the date and time designated for receipt of Bids, a Bidder may submit a new Bid to replace a Bid previously submitted, or withdraw its Bid entirely, by notice to the party designated to receive the Bids. Such notice shall be received and duly recorded by the receiving party on or before the date and time set for receipt of Bids. The receiving party shall verify that replaced or withdrawn Bids are removed from the other submitted Bids and not considered. Notice of submission of a replacement Bid or withdrawal of a Bid shall be worded so as not to reveal the amount of the original Bid.

§ 4.4.2 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids in the same format as that established in Section 4.3, provided they fully conform with these Instructions to Bidders. Bid security shall be in an amount sufficient for the Bid as resubmitted.

§ 4.4.3 After the date and time designated for receipt of Bids, a Bidder who discovers that it made a clerical error in its Bid shall notify the Architect of such error within two days, or pursuant to a timeframe specified by the law of the jurisdiction where the Project is located, requesting withdrawal of its Bid. Upon providing evidence of such error to the reasonable satisfaction of the Architect, the Bid shall be withdrawn and not resubmitted.

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

If stipulated in an advertisement or invitation to bid, or when otherwise required by law, Bids properly identified and received within the specified time limits will be made public and available to Bidders.

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§ 5.2 Rejection of Bids
Unless otherwise prohibited by law, the Owner shall have the right to reject any or all Bids.

§ 5.3 Acceptance of Bid (Award)
§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest responsive and responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. GFIAA, at its sole discretion, reserves the right to award to the Respondent whose response is deemed most advantageous to GFIAA. GFIAA, at its sole discretion, shall select the most responsive and responsible Respondent and evaluate all responses based on the requirements and criterion set forth in this solicitation while reserving the right to weigh specifications and other factors in the award.

§ 5.3.2 Unless otherwise prohibited by law, the Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the lowest responsive and responsible Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION

§ 6.3 Submittals
§ 6.3.1 After notification of selection for the award of the Contract, the Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, submit in writing to the Owner through the Architect:

- **.1** a designation of the Work to be performed with the Bidder's own forces;
- **.2** names of the principal products and systems proposed for the Work and the manufacturers and suppliers of each; and
- **.3** names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

§ 6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, withdraw the Bid or submit an acceptable substitute person or entity. The Bidder may also submit any required adjustment in the Base Bid or Alternate Bid to account for the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND
§ 7.1 Bond Requirements
§ 7.1.1 The Bidder shall furnish a Performance Bond and a Payment Bond will be required, each in an amount equal to 25 percent of the Contract Sum .

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§ 7.2 Time of Delivery and Form of Bonds

§ 7.2.1 The Bidder shall deliver the required bonds no later than the date of execution of the Contract. Owner may deem the failure of the Bidder to deliver required bonds within the period of time allowed a default.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond.

§ 7.2.3 Bonds shall be executed and be in force on the date of the execution of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix to the bond a certified and current copy of the power of attorney.

ARTICLE 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

§ 8.1 Copies of the proposed Contract Documents have been made available to the Bidder and consist of the following documents:

.1 AIA Document A101, Standard Form of Agreement Between Owner and Contractor.

.2 AIA Document A101, Exhibit A, Insurance and Bonds.

.3 AIA Document A201, General Conditions of the Contract for Construction.

.4 AIA Document E203, Building Information Modeling and Digital Data Exhibit.

DRAFT

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DOCUMENT 00 26 00
PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.

B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 01 25 00 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.3 PROCUREMENT SUBSTITUTIONS

A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.

B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:

1. Extensive revisions to the Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

A. Procurement Substitution Request: Procurement Substitution Request must be made in writing in compliance with the following requirements:

1. Requests for substitution of materials and equipment will be considered if received no later than **10** days prior to date of bid opening.

2. Submittal Format: Submit Procurement Substitution Request, using Exhibit 00 26 00A - Substitution Request.

B. Architect's Action:

1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

END OF DOCUMENT 00 26 00

CONTRACTOR'S SUBSTITUTION REQUEST FORM

Project Name: SRE Building Expansion

C&S Project No: K19012001

Owner: Gerald R. Ford International Airport Authority

Architect/Engineer: C&S Engineers, Inc

Contractor: _____

CONTRACTOR'S REQUEST WITH SUPPORTING DATA:

Substitution Request No.: _____ Date of Issuance:_____

We request your consideration of the substitution of following proposed product instead of the Specified Product:

Section No. _____ Paragraph No. _____ Specified ___ Product _____

Proposed Product:

[_] Product Data for proposed product is attached, including product description, reference standards, performance and test data.
[_] Sample(s) is(are) attached.
[_] Sample(s) will be sent if requested by the Architect.

Itemized comparison of proposed product with Specified Product:

	Specified Product	**Proposed Product**
Name/Brand	_____	_____
Catalog No.	_____	_____
Manufacturer	_____	_____

CONTRACTOR'S SUBSTITUTION REQUEST FORM
(Continued)

Significant Qualities	_____	_____
Unit Cost	$_____ per _____	$_____ per _____

[_] Material Only [_] Material and Installation

Proposed change to the Contract Sum:

Credit to the Owner: <$_____>
Additional Cost to the Owner: <$_____>

The Contract Time: Will be [Increased] [Decreased] by _____ calendar days.

Describe what effect this substitution will have on the other parts of the Work or on other contracts.

CONTRACTOR'S CERTIFICATION OF CONFORMANCE OF THE SUBSTITUTION OF THIS PROPOSED PRODUCT TO CONTRACT REQUIREMENTS:

We have investigated the substitution of this proposed product and:

1. Believe that it is equal or superior in all respects to the Specified Product, except as fully described in the comparison above;
2. Will provide the warranty as required by the General Conditions;
3. Will provide the special warranty, if any, as specified;
4. Have included all cost data and cost implications;
5. Will pay re-design and special inspection costs caused by the substitution this proposed product;
6. Will pay additional costs to other contractors caused by the substitution of this proposed product;
7. Will coordinate the incorporation of the substitution of this proposed product into the Work;
8. Will modify, or cause to be modified, other parts of the Work as may be required, or directed, to make all parts of the Work complete; and
9. Waive future claims for added costs to this Contractor caused by the substitution of this proposed product.

Signature _____ Date _____

Name (Typed) _____ Phone_____

END of Exhibit 00 26 00A

DOCUMENT 00 31 13
PRELIMINARY SCHEDULES

1.1 PROJECT SCHEDULE

A. The following Project Schedule indicates anticipated project milestones and is intended to supplement rather than serve in lieu of Bidders' own investigations. Bidder shall submit a preliminary schedule with their bid outlining their preliminary work plan.

B. The construction schedule may not vary from what is indicated due to material or manpower availability. In no event shall the construction schedule be allowed to be used as a basis for additional compensation for actual construction activities earlier or later than indicated on the Construction Schedule.

C. Preliminary Construction Schedule Milestones:

Release Documents for Bid	September 18, 2023
Pre-Bid Meeting	October 4, 2023
Bid Opening	October 25, 2023
Commission Approval	November 15, 2023
Anticipated Award	November 29, 2023
Notice to Proceed	March 4, 2024
Substantial Completion Phase 1 (Work Area A, B, C)	April 3, 2024
Substantial Completion for Operational Facility Use	**October 18, 2024**

- *Work that must be complete includes slab, building shell, overhead doors, exterior pavement adjacent to overhead doors, fire suppression updates, life safety, preliminary COI*
- *Subject to Liquidated Damages*

Target Substantial Completion Phase 2 (Work Area B, C) October 18, 2024

- *Other interior work NOT required for Operational Facility Use can occur after October 18, 2024, but cannot impact snow operations*
- *Depending on weather and remaining work, contractor might need to complete remaining work in Q1 or Q2 2025*

Target Substantial Completion Phase 3 (Work Area D) November 17, 2024

- *Work for Phase 3 occurs concurrently with Phase 2 following building erection*
- *Exterior work NOT impacting snow operations has no restrictions*
- *Depending on weather and remaining work, contractor might need to complete remaining work in Q1 or Q2 2025*

Commissioning	November 17, 2024
Final Completion and Closeout	January 17, 2024

END OF DOCUMENT 00 31 13

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DOCUMENT 00 31 32
GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. A geotechnical investigation report for Project is attached as Exhibit 00 31 32A.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

D. Related Requirements:

1. Document 00 21 13 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF DOCUMENT 00 31 32

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DOCUMENT 00 41 13
BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: SRE Building Expansion

C. Project Location: 4800 Patterson Avenue, Grand Rapids, Michigan 49512

D. Owner: Gerald R. Ford International Airport Authority

E. Architect: C&S Engineers, Inc.

1.2 CERTIFICATIONS AND BASE BID

A. Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

1. _____ Dollars ($_____).

1.3 SCHEDULE OF ALTERNATES

A. Refer to Specification Section 01 23 00 'Alternates.'

Alternate No. 1: Maintenance Building Overhead Door Replacement

1. ADD__X__ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

1.4 SCHEDULE OF ALLOWANCES

A. Refer to Specification Section 01 21 00 'Allowances.'.

1.5 SUBCONTRACTORS AND SUPPLIERS

A. The following companies shall execute subcontracts for the portions of the Work indicated. The assigned DBE contract requirement on this project is 3% of the total construction bid amount:

	DBE? Y/N	Approx. Value
Civil / Site Work: _____	_____	_____
Concrete Work: _____	_____	_____
Roofing Work: _____	_____	_____
Plumbing Work: _____	_____	_____
HVAC Work: _____	_____	_____
Electrical Work: _____	_____	_____
Security Work: _____	_____	_____
Other Work: _____	_____	_____
Other Work: _____	_____	_____
Other Work: _____	_____	_____

1.6 ACKNOWLEDGEMENT OF ADDENDA

A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. Addendum No. 1, dated _____.
2. Addendum No. 2, dated _____.
3. Addendum No. 3, dated _____.
4. Addendum No. 4, dated _____.

1.7 BID SUPPLEMENTS

A. The following supplements are a part of this Bid Form and are attached hereto.

1. Bid Bond Form (AIA Document A310).
2. Contractor's Qualification Statement (AIA Document A305)
3. Preliminary Project Schedule

1.8 CONTRACTOR'S LICENSE

A. The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in the State of Michigan.

1.9 SUBMISSION OF BID

A. Respectfully submitted this _____ day of _____, _____.

B. Submitted By:_____(Name of Organization).

C. Authorized Signature:_____(Handwritten signature).

D. Signed By:_____(Type or print name).

E. Title:_____(Owner/Partner/President/Vice President).

F. Attest:_____(Handwritten signature).

G. By:_____(Type or print name).

H. Title:_____(Corporate Secretary or Assistant Secretary).

I. Street Address:_____.

J. City, State, Zip:_____.

K. Phone:_____.

L. License No.:_____.

M. Federal ID No.:_____(Affix Corporate Seal Here).

1.10 BIDDER'S CHECKLIST

A. In an effort to assist the Bidder in properly completing all documentation required, the following checklist is provided for the Bidder's convenience. The Bidder is solely responsible for verifying compliance with bid submittal requirements.

B. Attach this completed checklist to the outside of the Submittal envelope.

1. Used the Bid Form provided in the Project Manual.
2. Prepared the Bid Form as required by the Instructions to Bidders.
3. Indicated on the Bid Form the Addenda received.
4. Attached to the Bid Form: Proposed Schedule of Values Form.
5. Attached to the Bid Form: Contractor’s Qualification Statement
6. Attached to the Bid Form: Bid Bond OR a certified check for the amount required.
7. Bid envelope shows name and address of the Bidder.

8. Bid envelope shows name of Project being bid.
9. Verified that the Bidder can provide executed Performance and Labor and Material Bonds.
10. Verified that the Bidder can provide Certificates of Insurance in the amounts indicated.

END OF DOCUMENT 00 41

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DOCUMENT 00 43 13
BID SECURITY FORMS

1.1 BID FORM SUPPLEMENT

A. A completed bid bond form is required to be attached to the Bid Form.

1.2 BID GUARANTEE

A. The Bidder shall provide a Bid Guarantee in the form of a cashier's check, certified check, U.S. money order, or bid bond, in an amount constituting five percent (5%) of the Base Bid.

B. In the event Owner does not offer Notice of Award within 60 days of receipt of bids, the Bid Guarantee shall be void.

1.3 BID BOND FORM

A. AIA Document A310-2010 "Bid Bond" is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.

B. Copies of AIA standard forms may be obtained from The American Institute of Architects; https://www.aiacontracts.org/; email: docspurchases@aia.org; (800) 942-7732.

END OF DOCUMENT 00 43 13

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DOCUMENT 00 43 73
PROPOSED SCHEDULE OF VALUES FORM

1.1 BID FORM SUPPLEMENT

A. Following receipt of Bids, a Proposed Schedule of Values form will be required from selected Bidder(s) within 2 business days of Owner request.

1.2 PROPOSED SCHEDULE OF VALUES FORM

A. Proposed Schedule of Values Form: Provide a breakdown of the bid amount, including alternates, in enough detail to facilitate continued evaluation of bid. Coordinate with the Project Manual table of contents. Provide line items for principal material and subcontract amounts in excess of **five 5** percent of the Contract Sum.

B. Arrange schedule of values using **AIA Document G703-1992** or similar format.

1. Copies of AIA standard forms may be obtained from the American Institute of Architects; https://www.aiacontracts.org/ library; (800) 942-7732.

END OF DOCUMENT 00 43 73

AIA® Document G703® – 1992

Continuation Sheet

AIA Document G702®, Application and Certification for Payment, or G732™, Application and Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:	001
APPLICATION DATE:	
PERIOD TO:	
ARCHITECT'S PROJECT NO:	1741-6772-70

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED		MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D + E + F)	% (G ÷C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
			FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD					
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
	GRAND TOTAL	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**0.00%**	**$0.00**	**$0.00**

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SECTION 00 52 13
CONTRACTOR'S AGREEMENT FORM

AGREEMENT:

The form of agreement between the Owner and the Contractor shall be the "Standard Form of Agreement Between Owner and Contractor" (AIA Document A101), as published by the American Institute of Architects. Refer to 'Exhibit 00 52 13A'.

END OF SECTION 00 52 13

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DRAFT

AIA® Document A101™ – 2017

Standard Form of Agreement Between Owner and Contractor
where the basis of payment is a Stipulated Sum

AGREEMENT made as of the day of in the year

BETWEEN the Owner:

Gerald R. Ford International Airport Authority
5500 44th Street Southeast
Grand Rapids, MI 49512

and the Contractor:

for the following Project:

SRE Building Expansion
4800 Patterson Avenue
Grand Rapids, MI 49512

The Architect:

C&S Engineers, Inc.
38777 Six Mile Road
Suite 202
Livonia, MI 48152

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101™–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201™–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

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4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

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8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[X] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

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§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[ ] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates: Not Applicable

Portion of Work	Substantial Completion Date

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be « » ($ « »), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.

(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:

(Identify each allowance.)

Item	Price

§ 4.4 Unit prices, if any:

(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

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Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the « » day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the day of the « » month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than « » (« ») days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and

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.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and

.5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

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.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

« » % « »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[X] Litigation in a court of competent jurisdiction – Kent County, Michigan

[ ] Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:

(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

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« »

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:
(Name, address, email address, and other information)

§ 8.3 The Contractor's representative:
(Name, address, email address, and other information)

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
.3 AIA Document A201™–2017, General Conditions of the Contract for Construction

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.4 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[« »] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
(Printed name and title)	*(Printed name and title)*

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SECTION 00 61 13
BONDS

A. BID BONDS

A **Bid Bond** will be required for this project, in the amount of ten percent (5%) of the total bid, including the high combination of all alternates. This bond shall be executed on AIA Document A310 (latest edition), or insurance company comparable form or a certified check. Refer to Exhibit 00 61 13A.

B. PERFORMANCE AND PAYMENT BONDS

The successful bidders will be required to furnish a Contract Performance Bond and Payment Bond equivalent to 25% of the amount of said contract subsequent to award of contract and prior to signing of contract. These bonds shall be executed on AIA Document A312. Refer to Exhibit 00 61 13B.

END OF SECTION 00 61 13

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AIA® Document A312™ – 2010

Payment Bond

CONTRACTOR:
(Name, legal status and address)

SURETY:
(Name, legal status and principal place of business)

OWNER:

Gerald R. Ford International Airport Authority
5500 44th Street Southeast
Grand Rapids, MI 49512

CONSTRUCTION CONTRACT
Date:
Amount: $
Description:
SRE Building Expansion
4800 Patterson Avenue
Grand Rapids, MI 49512

BOND
Date:
(Not earlier than Construction Contract Date)

Amount: $

CONTRACTOR AS PRINCIPAL
Company: *(Corporate Seal)*

Signature:

Name and Title:

SURETY
Company: *(Corporate Seal)*

Signature:

Name and Title:

(Any additional signatures appear on the last page of this Payment Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or **BROKER:**

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

- **.1** have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
- **.2** have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim,

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except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

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.1 the name of the Claimant;
.2 the name of the person for whom the labor was done, or materials or equipment furnished;
.3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
.4 a brief description of the labor, materials or equipment furnished;
.5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
.6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
.7 the total amount of previous payments received by the Claimant; and
.8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

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CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:	« »	Signature:	« »
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

DRAFT

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AIA® Document A312™ – 2010

Performance Bond

CONTRACTOR:
(Name, legal status and address)

SURETY:
(Name, legal status and principal place of business)

OWNER:

Gerald R. Ford International Airport Authority
5500 44th Street Southeast
Grand Rapids, MI 49512

CONSTRUCTION CONTRACT
Date:
Amount:
Project:

SRE Building Expansion
4800 Patterson Avenue
Grand Rapids, MI 49512

BOND
Date:
(Not earlier than Construction Contract Date)

Amount: $

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:		Name and Title:	

(Any additional signatures appear on the last page of this Performance Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or **BROKER:**

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

.1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

.2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

.3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

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§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

.2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and

.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said

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statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL			**SURETY**		
Company:		*(Corporate Seal)*	Company:		*(Corporate Seal)*
Signature:	« »		Signature:	« »	
Name and Title:	« »« »		Name and Title:	« »« »	
Address:	« »		Address:	« »	

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SECTION 00 62 16
CERTIFICATE OF INSURANCE

CERTIFICATE OF INSURANCE

Before the execution of the contract, the successful bidder shall submit to the Owner evidence of Insurance on **ACORD Form 25-S CERTIFICATE OF INSURANCE**.

Certificates of Insurance are acceptable only if the Project name and Contractor name are clearly identified on the form itself and if the Contractor, the Owner, the Architect/Engineer, are identified as additional insureds.

THE FOLLOWING ARE ADDITIONAL INSUREDS UNDER THE GENERAL LIABILITY POLICY BUT ONLY WITH RESPECT TO LIABILITY ARISING OUT OF THE WORK PERFORMED BY OR ON BEHALF OF THE NAMED INSURED FOR PROJECT:

OWNER:

Gerald R. Ford International Airport Authority
5500 44th Street Southeast
Grand Rapids, MI 49512

ARCHITECT:

C&S Engineers, Inc.
38777 Six Mile Road
Suite 202
Livonia, MI 48152

END OF SECTION 00 62 16

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SECTION 00 72 13
GENERAL CONDITIONS –STIPULATED SUM (Single-Prime Contract)

AIA Document A201 "General Conditions of the Contract for Construction" is hereby made a part of the Contract Documents and is attached herein. See **EXHIBIT '00 72 13 A',** AIA Document A201 2007.

END OF SECTION 00 72 13

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DRAFT

AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

SRE Building Expansion
4800 Patterson Avenue
Grand Rapids, MI 49512

THE OWNER:

Gerald R. Ford International Airport Authority
5500 44th Street Southeast
Grand Rapids, MI 49512

THE ARCHITECT:

C&S Companies
38777 Six Mile Road
Suite 202
Livonia, MI 48152

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For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants

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under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

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§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

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§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

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§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of

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the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

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§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies

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necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- **.1** allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

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.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to

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indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

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§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably

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withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

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ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require

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inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

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§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents,

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assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules.

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The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

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ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- **.1** The change in the Work;
- **.2** The amount of the adjustment, if any, in the Contract Sum; and
- **.3** The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- **.1** Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- **.2** Unit prices stated in the Contract Documents or subsequently agreed upon;
- **.3** Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- **.4** As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting

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together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the

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Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

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ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and

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payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor;

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.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or

.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment

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was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the

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date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final

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payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- **.1** employees on the Work and other persons who may be affected thereby;
- **.2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

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.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the

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site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time

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claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies with ratings of no less than A as determined by A.M. Best Company licensed to do business in the state where the project is located and to which the Owner has no reasonable objection , such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- **.1** Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed including private entities work at the site and exempt from the coverage on account of number of employees or occupation, which entities shall maintain voluntary compensation at the same limits specified for mandatory coverage for the duration of the project;
- **.2** Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees or persons or entities excluded by statue from the requirements of Clause 11.1.1.1, but required by the Contract Documents to provide the insurance required by the Clause;
- **.3** Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- **.4** Claims for damages insured by usual personal injury liability coverage;
- **.5** Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- **.6** Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- **.7** Claims for bodily injury or property damage arising out of completed operations; and
- **.8** Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 Liability Insurance shall include all major divisions of coverage and be a comprehensive basis including:

- **.1** Premises Operations (including X, C and U coverage as applicable).
- **.2** Independent Contractor's Protective.
- **.3** Products and Completed Operations.
- **.4** Personal Injury Liability with Employment Exclusion deleted.
- **.5** Contractual, including specified provision for Contractor's obligation under Paragraph 3.18.
- **.6** Owned, non-owned and hired motor vehicles.
- **.7** Broad Form Property Damage, including Completed Operations.

§ 11.1.3 If the General Liability coverages are provided by a Commercial General Liability Policy on a Claims-Made basis, the policy date or Retroactive Date shall pre-date the Contract; the termination date of the policy or applicable extended reporting period shall be no earlier than the termination date of coverages required to be maintained after final payment, certified in accordance with Subparagraph 9.10.2.

§ 11.1.4 Before starting work, the contractor shall furnish to the Owner, through the Architect, duly executed

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certificates of all required insurance on the latest edition of AIA Form G705 or on an ACCORD Form 25 or 255 current edition. The certificates shall also state that such insurance is in force and cannot be canceled or released except upon thirty (30) days prior written notice to the Owner with a copy to the Architect/Engineer. All policies shall be written specifically for this project, with the name of the project and additional insured(s) on said policies.

§ 11.1.5 It shall be the Contractor's responsibility to provide the Architect with written certification of renewal of insurance in sufficient time no later than fifteen (15) days prior to policy expiration date. The Contractor shall provide the Architect with a copy of said renewal certification. Allowing the insurance to expire is a breach of contract on the part of the Contractor and shall be grounds to immediately stop the work by direction of the Owner. No work shall proceed until renewal insurance has been reviewed and approved by the Architect. The Contractor will be liable to make up the lost time and for any expenses incurred by others due to mandated work stoppages.

§ 11.1.6 All insurance required under this Article 11 shall remain in effect for a period of one (1) year from date of Substantial Completion. The Owner, and Architect shall be as named additional insureds on all liability policies.

§ 11.1.7 The insurance required by Section 11.1.1 shall be written for not less than identified limits or as required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.8 Prior to the commencement of any work and prior to the performance of any service, the Contractor shall procure and pay for the following insurance coverage's, and the Contractor shall maintain them in force after his work is completed and accepted for final payment and throughout the warranty period. The insurers and policies shall be subject to the Owner's approval.

§ 11.1.9 Workmen's Compensation

.1 Statutory Workmen's Compensation and Occupational Disease Insurance with all elective employment's covered and all excluded employment covered on a voluntary basis where permissible.

.2 The Workmen's Compensation policy shall contain the following endorsement, unless specifically prohibited by compensation insurance authorities having jurisdiction:

Whereas, Contractor may undertake to perform work for the Owner; and whereas said Owner may exercise some degree of jurisdiction or control over the employees of Contractor engaged in such work, it is agreed that, subject to the conditions and limitations of this policy, said Owner is named as an additional insured employer under this policy, buy only with respect to employees of Contractor whose names appear on the payroll records of Contractor while performing such work for said company.

§ 11.1.10 Bodily Injury and Property Damage Liability

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.1 The liability policy shall be on a comprehensive liability form and shall include, but not be limited to, coverage for all operations of the Contractor, including automobile, premises, contractual liability, completed operations liability, Contractor's protective liability and contingent liability for the operations of subcontractors.

.2 The Contractor shall affect and maintain insurance covering himself or his agents, the Owner or its assignee, the Architect and their consultants against all claims, demands or actions arising under the Michigan Workmen's Compensation Law against all other claims, demands or actions for injury to, or death of, persons and damage to property, and will furnish the Owner with certificates showing the following coverage is in complete satisfaction to the Owner.

.1 Worker's Compensation Insurance, Occupational Disease Insurance and Employer's Liability Insurance for all employees engaged in the work under this agreement.

.2 Comprehensive General Liability Insurance, including Contractor's protective Liability, Completed Operations, Blanket Contractual and Personal Injury Liability, and Coverage as Respects the Explosion, Collapse, and Underground Hazards:

a) Bodily Injury: $1,000,000 Each Occurrence

b) Property Damage: $300,000 Each Occurrence
Min. $900,000 Aggregate

c) Products and Completed Operations to be maintained for two years after final payment.

d) Property Damage Liability Insurance shall include completed operations:

.3 Contractual Liability (Included in No. 2)

.4 Business Auto Liability (including owned, non-owned and hired vehicles):

a) Bodily Injury $500,000 Each Person

b) Property Damage: $100,000 Each Occurrence

.5 Umbrella Excess Liability:

a) Over Primary Insurance $5,000,000

.6 In addition to the limits specified herein, the policy shall also include the following endorsements to the "Owners' and Contractors' Protective Liability Insurance.

a) Whenever used in this policy, the term "named insured" shall include the Owner, its members and employees.

b) Wherever used in this policy, the term "general supervision" shall include on-site inspection, field engineering, field testing, and activities incidental thereto.

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§ 11.1.11 Indemnification: See Article 3.18 'Indemnification' on Page 6 of AIA Document A201, "General Conditions of the Contract for Construction", 2007 edition

§ 11.1.12 The policy of insurance referred to above shall contain the following endorsement:

It is further understood and agreed that the coverage of this policy shall not be canceled or reduced by the company until the company has mailed written notice to Owner stating when, but in no case less than thirty (30) days thereafter, such cancellation or reduction in coverage shall be effective.

The Contractor shall indemnify and hold harmless, the Owner or assignee, the Architect and their agents and employees in accord with Article 3.18, "Indemnification" of the General Conditions of the Contract for Construction, AIA Document A201, 2007 edition.

The policy provided by the Contractor shall provide coverage for the professional acts of that Contractor.

For the duration of this Contract, Contractor shall maintain Comprehensive Automobile Liability Insurance for all owned, non-owned and hired vehicles. Contractor shall require subcontractors to provide Comprehensive Automobile Liability Insurance with same minimum limits.

Contractor shall not commence work at the site under this Contract until he has obtained all required insurance, and until such insurance has been approved by the Owner and Architect. The Contractor shall not allow any subcontractor to commence work until all insurance required has been obtained and approved. Approval of the insurance, by the Owner and Architect, shall not relieve or decrease the liability of the contractor hereunder. Certificates of Insurance shall be filed with the Owner and Architect prior to commencing work.

The Contractor shall be responsible for his subcontractors required insurance prior to commencing work.

Proof of Carriage: The Contractor shall furnish the Owner and Architect with satisfactory proof of carriage of the insurance required as provided under the Laws of the State of Michigan. No work shall be started by either Contractor or subcontractor until such certificates are delivered. Owner reserves the right to stop work in all cases where such renewal certificates and insurance policies are not delivered to Owner prior to the expiration date shown on the policies and/or certificates.

All Contractors' insurance policies shall name the Owner and/or its representatives or assignees, the Trustee, the Architect/Engineer as additional insureds, and shall deliver evidence of such insurance to the Owner.

§ 11.1.13 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or

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replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.14 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.1.15 Furnish one copy of the certificate for each copy of the Owner-Contractor Agreement. Specifically set forth evidence of all insurance required of the Contractor by this Article 11. The form of the certificate shall be AIA Document G705, ACORD Form 25 or Form 25S, current edition. Furnish copies of any endorsements that are subsequently issued amending coverage or limits.

§ 11.1.15.1 The "Certificate Holder" shall be listed as **the Gerald R. Ford International Airport Authority.**

§ 11.1.15.2 C&S Engineers, Inc. shall be listed as an Additional Insured**.**

§ 11.1.16 The Contractor's owned, leased, hired and/or borrowed equipment, supplies, and materials stored on or off site, and tools, not forming a part of or incorporated into the Work, is not covered by the Owner's Builders Risk Insurance. The Contractor, lender, or other type of owner of said mentioned equipment, shall not have claim against the Owner of this project, for any reason whatsoever, for loss of such equipment mentioned above which is used on this project.

§ 11.1.17 In addition to the limits specified herein, the policy shall also include the following endorsement to the Owner's and Contractors' Protective Liability Insurance:

.1 Wherever used in this policy, the term "Insured" shall include the Owner and Architect
.2 Wherever used in this policy, the term "General Supervision" shall include on-site inspection, field engineering, field testing and activities incidental thereto.

§ 11.2 OWNER'S LIABILITY INSURANCE
The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 PROPERTY INSURANCE
§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later.

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§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's and Contractor's services and expenses required as a result of such insured loss.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then affect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.1.6 Builder's All Risk - The Owner shall purchase and maintain Builders Risk Property Insurance upon the entire Work at the site for One Hundred (100%) percent of the full value thereof. Said insurance shall cover the building under construction and all materials which are incorporated into the work. The Owner and Contractors waive all rights against each other for damages caused by the perils covered by such insurance. Equipment of the Contractors and materials, which are not yet incorporated into the building, will not be insured by the Owner.

Furthermore, it is the Contractor's responsibility to insure himself against those claims for theft, vandalism and other such items which are not contained in the Owner's Builder's Risk Policy. Each Contractor shall insure himself against claims for the theft and vandalism of his materials and equipment stored on the site in trailers, buildings, etc., which are not yet a permanent part of the work.

§ 11.3.2 BOILER AND MACHINERY INSURANCE

The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

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§ 11.3.3 LOSS OF USE INSURANCE
The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

§ 11.3.4 If the Contractor requests in writing that insurance for special hazards or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 11.3.7 WAIVERS OF SUBROGATION
The Owner and Contractor waive all rights against (1) each other and the subcontractors, sub-subcontractors, agents and employees each of the other, and (2) the Architect, Engineer, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and if the person or entity had an insurable interest in the property damaged. The policies shall not prohibit waivers of subrogation.

§ 11.3.8 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

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§ 11.3.10 The Owner as Trustee, shall have the power to adjust and settle any loss with the insurers.

§ 11.3.11 This coverage shall not be terminated until final payment to the Contractor or occupancy. The insurance company and/or Owner shall give ten (10) days written notice to the Architect, and Contractors prior to termination of policies provided under the provisions of Property Insurance.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 Each contractor to whom awards are made shall furnish a Contract Performance Bond and Labor and Material Payment Bond within ten (10) days after official notice of the Contract by the Owner. The bonding and surety company must be approved or licensed to transact a fidelity and surety business in the state in which this Project is located and, further, shall be listed in the latest edition of the U.S. Federal Register, Department of Treasury, Bureau of Accounts.

§ 11.4.2 Said Contract Performance Bond and Labor and Material Payment Bond shall be in an amount at least equal to One Hundred (100%) Percent of the Contract price as security for:

.1 The faithful performance of all provisions of the Contract and the satisfactory completion of the Work.

.2 The payment of all persons performing labor and furnishing materials in connection with the Contract.

.3 The covering of all guarantees included herein

§ 11.4.3 The Contractor shall deliver the required bonds including Subcontractor's Bonds to the Owner not later than three days following the date the Agreement is entered into, or if the work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to the commencement of the work, submit evidence satisfactory to the Owner that such bonds will be furnished.

§ 11.4.4 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.4.5 The Contractor shall deliver the required bonds to the Owner no later than the date of execution of the contract. The Owner or Architect shall not be responsible for any costs associated with securing the bond should the project be canceled prior to contracts being fully executed.

.1 Said bonds shall remain in full force and effect, during the life of the contract and for a period of at least 12 months after the date of final completion and Owner's acceptance of the work provided under the Contractor's contract. Should the Contractor's bonding company default, the Contractor will be responsible for securing a new bond within fourteen (14) calendar days.

.2 Contractor shall keep his Bonding Company informed of any and all changes in amount of his contract with the Owner and shall furnish the Architect with copies of all notices of such changes upon request.

§ 11.4.6 Performance Bond and Labor and Material Payment Bond shall be executed by a surety acceptable to the Owner on the edition of AIA Documents A311/A312 current as of the date of the award of the Contract.

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§ 11.4.7 The Contractor shall use as a Surety for the applicable bond one of the acceptable companies determined strictly in accordance with the following: Insurance and Surety companies shall be deemed qualified and acceptable to the Owner's Legal Counsel, in connection with Contractor bonding and insurance requirements under said Contracts only if such companies have a Policy Holders Rating of "A", a financial category not less than Class VI and Policy Holder Surplus of not less than $25,000,000.00 all as shown on "Best's Key Rating Guide", latest edition, provided, however, that the bond furnished is furnished by one of the aforesaid qualified Sureties who is also listed in the Department of the Treasury Circular 570 - Volume 41 No. 132, Part V (Federal Register) and is licensed in the State of Michigan and the penal sum of the bond does not extend the underwriting limitation set forth in the subject Circular, unless the excess, if any, is reinsured with the approval of the Owner

§ 11.4.7.1 The Contractor shall deliver the required bonds to the Owner prior to the date of execution of the contract and fourteen (14) days prior to the date set for bond closing. The Owner and/or Architect shall not be responsible for any costs associated with securing the bond should the project be canceled prior to contracts being fully executed.

§ 11.4.7.2 Said bonds shall remain in full force and effect during the life of this contract and for a period of at least 24 months after the date of final completion of the contract. Should the Contractor's bonding company give notice of cancellation, the Contractor will be responsible for securing a new bond prior to termination.

§ 11.4.7.3 Performance Bond and labor and Material Payment Bond shall be security for the following:

.1 The faithful performance of all provisions of the Contract and satisfactory completion of the work included thereunder.

.2 The payment of all persons performing labor and furnishing materials in connection with the Contract.

.3 The covering of all guarantees included herein.

.4 In addition to the paragraphs above, this Bond shall guarantee the Owner for a period of two (2) years after the date of acceptance of the work by the Owner that all workmanship and materials performed and furnished as part of this Contract are in accordance with the Drawings and Specifications, and that the Contractor shall remove any defects due to faulty workmanship and/or materials that shall appear within the guarantee period.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may

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be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

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§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect

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will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- **.3** Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- **.4** The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

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§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- **.4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- **.1** Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- **.2** Accept assignment of subcontracts pursuant to Section 5.4; and
- **.3** Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

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§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim

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or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- **.1** damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- **.2** damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

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§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a

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Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity

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administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

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Continuation Sheet

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing Subcontractor's signed certification is attached.
In tabulations below, amounts are in US dollars.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:	001
APPLICATION DATE:	
PERIOD TO:	
ARCHITECT'S PROJECT NO:	

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED FROM PREVIOUS APPLICATION (D + E)	WORK COMPLETED THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D + E + F)	% (G ÷ C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
	GRAND TOTAL	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**0.00%**	**$0.00**	**$0.00**

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SECTION 01 10 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under Owner's separate contracts.
4. Contractor's use of site and premises.
5. Work restrictions.
6. Specification and Drawing conventions.
7. Miscellaneous provisions.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 01 73 00 "Execution" for coordination of Owner-installed products.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. New SRE Building Expansion totaling approximately 65,000sf. The new facility will be constructed adjacent to the existing Maintenance Building, located on the secure side of the airport perimeter secure fence. The proposed project includes Civil/Site Development, Architectural, Mechanical, Electrical, Fire Protection, Security, and Technology Systems. The proposed project is steel framed on concrete foundations; construction is Type II-B; occupancy is Group S-1.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 WORK UNDER BASE-BID BY PRE-SELECTED VENDORS

A. Work with Pre-Selected Vendors: The following vendors have been pre-selected by the Owner to perform work for this contract under the Base-Bid. Contact the following for coordination of scope and budget.

1. Security System: SecurAlarm
   a. Contact: Gloria Lubben, glubben@securalarm.com, 616.293.6385

2. Speaker, Paging: Parkway
   a. Contact: Todd Billin, todd.billin@parkway.us, 616.820.1289

3. Fire Alarm: SecurAlarm
   a. Contact: Gloria Lubben, glubben@securalarm.com, 616.293.6385

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: Contractor shall have full use of the non-secure (Landside) of the Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Restricted Use of Site: A minor portion of building and site development occurs on the secure (Airside) of the project site. Contractor shall have limited use of this area; refer to Section 010120 – Special Project Procedures.

C. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

   a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.6 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Work hours are not limited; coordinate work plan with Owner prior to mobilization.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others without prior coordination and approval.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 14 01
SPECIAL PROJECT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- Security of Existing Facilities
- Emergencies
- Airport Security
- Interruptions to Existing Facilities.
- Keys and Locks
- Lockout/Tagout
- Hazardous Material
- Hot Work Permits
- Confined Space Entry Regulations
- Use of Fire Hydrants

1.2 RELATED REQUIREMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SECURITY OF EXISTING FACILITIES

Security of existing facilities must be maintained at all times. When entrance into secured areas is required at any time by badged or escorted workers, it must be coordinated with the Airport prior to beginning project work. Strict limitations will be set and enforced as to where Contractor personnel can go.

- Any violations of these limits will subject violator to immediate discharge from this project at the Airport's request.

The project includes construction operations within the Airport Secured Area.

1.4 EMERGENCIES

All emergency calls, including 911 calls, should be made to the Airport Communications Center at **616-233-6055**.

- Fire Emergencies: Report all fires, smoke smells, etc., to the Airport Communications Center.
- Medical Emergencies: Report medical emergencies requiring assistance to the Airport Communications Center.
- Security Violations: Report any suspicious activity within the Secured Area, Air Operations Area (AOA), and Cargo SIDA Area and violations to the Airport Security Program or Airport Rules and Regulations to the Airport Communications Center.
- Other Emergencies: Other emergencies, such as fuel and oil spills or illicit storm water discharges shall be reported immediately to the Airport Communications Center.

1.5 AIRPORT SECURITY

It is essential that during the performance of this contract, airport security be maintained and that construction operations conform to Airport security requirements.

Airport-Issued Identification Badges: Identification badges are issued by the Airport Badging Office to provide authorized access to employees performing job duties within the airport. The Contractor assumes responsibility for the conduct of all personnel working at the construction site and on airport property. Contractors working within the Secured Area must display an airport-issued identification badge or be escorted by personnel with a badge who has been granted escort privileges. Identification badges must be worn on an individual's outermost garment and above the waist at all times.

- The airport encourages all contracted personnel to be badged. *Any unbadged individuals must be under escort at all times per TSA regulations.* This will be strictly enforced.
- Badges are the property of the Airport and must be returned promptly upon completion of a subcontractors work, individual termination, or project completion. Failure to return badges may result in the Contractor being declared nonresponsive and ineligible for future Airport contracts.

Pre-Badging Requirements for General Contractor: Contractor should coordinate badge requirements with the Airport Project Manager. DO NOT WAIT UNTIL THE LAST MINUTE. The following documents are required before beginning the badging process:

- Project Letter from Contractor – Letter must include the Project Name with Start Date and estimated End Date, PLUS a list of Subcontractors. For subcontractors include company name, address, telephone number and contact person.
- Designate Authorized Signatories – Companies will designate a small number of individuals to be Authorized Signatories to enroll employees for airport IDs. These individuals must obtain their Airport badge and complete authorized signatory training prior to enrolling other individuals.
- New Airport Company Request Form – All Contractor/Subcontractor companies that will be performing work at the airport need to fill out a new airport company request form in order to be added in the SAFE Badging System prior to beginning the badging process. Forms can be obtained from the Airport Badging Office.
- All airport-issued ID badge applications and ID badge renewals must be submitted electronically to the Airport Badging Office through the SAFE® ID Badging portal. Information will be covered during the Authorized Signatory training.
- All ID Badge application/background checks and training must be scheduled online at www.grrbadging.as.me

Badging Process – General Information: The badging process requires two (2) scheduled visits to the Airport Police office for each applicant.

- Badge Application and Background Checks
- The background process begins with the scheduled initial visit, including fingerprinting and document verification. Each applicant must schedule an initial visit with the Airport Badging Office at www.grrbadging.as.me
- Authorized Signatories will enter a badge applicant's biographic information, ID badge type and access privileges into the SAFE badging portal.
- Applicant will complete an Airport Fingerprint Application prior to coming to the Airport.
- Applicant will bring two (2) acceptable forms of identification (from the USCIS I-9 Form) to the Airport Badging Office.
- The airport will perform two (2) background checks on the applicant:

a) A security threat assessment (STA) is a name verification background check conducted by TSA.
b) A criminal history records check (CHRC) is a fingerprint-based background check by the FBI to determine if the badge applicant has been convicted of a disqualifying criminal offense (as identified on the fingerprint application) within the last ten (10) years.

- Allow 15 minutes during the first visit to complete this process. Background check results should be received within 2-14 days. The Contractor's authorized signatory will be notified by the Badging Office once the applicant has been approved. The authorized signatory will be responsible for notifying the applicant. The applicant will then have 30 days to schedule and complete badge training. Failure to complete training within the 30 day limit will result in their application being denied.
- The Contractor is responsible for providing a "Security Awareness Document for Badged Contractors and Subcontractors" document (provided by the Airport) to all badge holders. The individual shall sign an attestation form acknowledging they have received and understand the document. Upon request of the Airport, the Contractor shall provide copies of the signed attestation forms to the Badging Office.

Training and Badge Issuance

Training appointments must be scheduled online at www.grrbadging.as.me. Upon successful completion of each required training program, the applicant will be issued their ID badge.

All initial badging fees will be at no cost to the Contractor. If an ID badge is lost, stolen, or otherwise unaccounted for, the ID badge replacement fee is $50.00 cash/card/check. The badge holder is responsible for paying the ID badge replacement fee prior to receiving their new ID badge.

All workers shall be subject to the airport's "Three Strikes" Security Compliance Program as defined in the Gerald R. Ford International Airport Rules & Regulations (https://www.grr.org/documents-forms). The Contractor is also subject to civil penalties issued by the Airport for security violations committed by either the Contractor's workers or a Subcontractor's workers.

Escorting Unbadged Workers

- Contractor personnel who have an operational need to access the Secured Area job site, but have not been issued an ID badge may work in the Secured Area provided they are under constant escort by another badged individual who has been granted escort privileges.
- Badged Contractor personnel who have been granted access and escort privileges must escort any unbadged Contractor personnel, vendor, truck driver, etc. that has not been issued an ID badge. The individual under escort must stay within "sight and sound" of the individual providing escort at all times.
- Badged Contractor personnel who do not have their airport-issued ID badge in their possession can not be escorted into the Secured Area for any reason.
- Violations of the escort policy shall be immediately reported to Airport Communications at 616-233-6055.

Access Gates: Construction vehicular traffic to and from the site shall be along the designated haul route depicted on the plans. If the project requires vehicular traffic to pass through a secured gate, the Contractor shall provide a badged gate guard whose qualifications have been approved by Airport Police at the access gate at any time the gate is unlocked. Airport Police will provide gate guard training and outline additional gate guard duties and requirements.

- The gate guard shall maintain a list of Contractors and Subcontractors who have been assigned to work on this project and shall permit access only to those persons whose company name appears on the list.
- The Contractor shall provide two-way communications between the gate guard and the Airport Communications Center; the gate guard shall immediately notify the airport communication center of any unauthorized access or other security issues.
- If the access gate is found to be open or unlocked and unattended, the Contractor shall be responsible for all court-imposed fines and Transportation Security Administration (TSA) fines and penalties up to $13,910.00 per occurrence. In addition, a $1,000.00 charge will be levied by the Airport for each violation so documented, and upon final payment the total of any such charges will be deducted from monies due the Contractor.

Access Doors: Construction personnel traffic to and from the site shall be allowed access via designated construction access doors only.

- The Contractor will be responsible for security of all access doors. Specific door requirements will be coordinated with Airport Police.
- If an access door or security gate is found to be open or unlocked and unattended, the Contractor shall be responsible for all court-imposed fines and Transportation Security Administration (TSA) fines and civil penalties up to $13,910.00 per occurrence. In addition, a $1,000.00 charge will be levied by the Airport for each violation so documented, and upon final payment the total of any such charges will be deducted from monies due the Contractor.

Operation of Privately-Owned Vehicles (POVs) in the Secured Areas:

- Company vehicles may operate in the Secured Area if the vehicle is necessary to perform the official job duties. Vehicle operators must maintain physical control of the vehicles at all times. All vehicles must have the company name clearly displayed on both sides of the vehicle or an airport-issued dash placard displayed while in the Secured Area.
- POVs are prohibited from operating, parking or any other presence in the Secured Area. An approved POV parking area will be provided and depicted on the plans.
- Definition of company vehicle: Vehicles must have state registration listing ownership to a company. The vehicle may be leased to a company as long as the lease is in the name of the company. All vehicles must have insurance in the name of the owner company and proof of insurance must be present in the vehicle at all times while on airport property.

Traffic Control: The Contractor shall provide flagmen as necessary to control construction traffic within the project limits and as shown on the project plans.

Safety During Construction: The Contractor shall inform all construction personnel as to the proper routes, speeds and procedures for transporting equipment and materials to the construction site and to all restrictions to movement of equipment or personnel within the Air Operations Area.

Security Gates and Doors or other Critical Equipment: The Contractor shall contact the Airport Project Manager prior to adding, repairing or working on any security gate, door, card readers or other critical equipment relevant to the operation of the airport security system and shall not begin work without prior authorization.

All security doors must closed and secured after use. This includes pushing or pulling on a door to ensure it is secure. If a door can not be secured, a badge holder must remain at the door and notify airport communication immediately. The badge holder must also remain at the door until airport staff arrive and and take “positive control” of the door.

1.6 INTERRUPTIONS TO EXISTING FACILITIES

All construction activities must be accomplished in such a manner as to permit normal airport and tenant operations within the existing facilities and roadway system. Major areas to be renovated/ remodeled within existing facilities will be made available upon written request by the Contractor to the Airport Project Manager.

- Such request shall be made with adequate lead-time so that the Airport and Tenants can make necessary adjustments to their operations.
- The existing public circulation corridors and required exits must remain open and unencumbered or provisions made for temporary egress.
- All electrical shutdowns and impacts to fire suppression systems shall be prearranged with the Airport Project Manager and notification shall be made to the Airport Communication Center (616-233-6055) prior to shut down.

It may be required that work which includes the abandonment or relocation of existing mechanical or electrical utilities; the relocation of existing mechanical or electrical systems or components; the connection of new mechanical or electrical systems or components to existing facilities, which will cause interruptions to the operations of the existing building and roadway system; or interruptions of airport tenant activities must be scheduled for times other than normal working hours. The Contractor shall schedule and coordinate its work to minimize the required interruptions, and shall notify the Airport in writing at least ten (10) working days prior to each intended interruption, indicating the estimated duration of the interruption and extent of impact to Airport facilities.

Traffic Control: The Contractor shall provide flagmen as necessary to control construction traffic within the project limits and as shown on the project plans. Traffic on public roads shall be maintained in accordance with the Manual of Uniform Traffic Control Devices, current edition, and as shown on the project plans.

1.7 KEYS AND LOCKS

Key requests can be made to the Airport Badging Office. Airport Police will provide key request form(s) to the Contractor. Airport security badge identification is required for issuance of all Airport keys.

After all signatures on the key request form(s) are in place and the applicant has an airport-issued identification badge, the key request will be processed.

Prior to final payment, all keys and airport issued padlocks must be returned to the Airport Police Department. Contractor understands that failure to return any key may require the replacement of all keys and rekeying of all security systems at the Contractor's expense. The Contractor may be subject to one or more of the following penalties:

- Revocation of Airport-issued security badges.
- Cost of replacement keys and padlocks plus re-keying expenses.
- Administrative penalty of $1,000.00.

1.8 LOCKOUT/TAGOUT PROCEDURES

The purpose of the procedure is to establish the minimum requirements for the lockout or tagout of energy isolation devices. Contractor shall ensure that procedures are used to ensure that the machine or equipment is isolated from all potentially hazardous energy, and locked out or tagged out before Contractor's personnel perform any servicing or maintenance activities where the unexpected energization, start-up or release of stored energy could cause injury.

Examples of stored energy where lockout/tagout applies are:

- Electrical
- Mechanical
- Thermal, steam

- Chemicals, acids, and caustics
- Natural gas
- Hydraulic
- Pneumatic
- Gravity

It is the responsibility of the Contractor to ensure that all appropriate Contractor personnel are instructed in the safety significance of the lockout or tagout procedure. Each new or transferred individual and other personnel whose work operations are or may be in the area shall be instructed in the purpose and use of the lockout or tagout procedure.

In preparation for lockout or tagout, the Contractor shall conduct a survey to locate and identify all devices to be certain which switch(es), valve(s), or other energy isolating devices apply to the equipment to be locked or tagged out. More than one energy source (electrical, mechanical, or others) may be involved. When more than one individual is required to lockout or tagout equipment, a multiple lockout or tagout device shall be used.

The basic rules for using the lockout or tagout system are that all equipment shall be locked out or tagged out to protect against accidental or inadvertent operation when such operation could cause injury to personnel. Do not attempt to operate any switch, valve, or other energy-isolating device where it is locked or tagged out.

A lockout/tagout will be required whenever performing the following work on machines or equipment.

- Required Lockout/Tagout

a) Maintenance or service work is defined as constructing, installing, setting up, adjusting, inspecting, modifying and maintaining, and/or servicing machines or equipment.
b) Before removal or bypass of any guard or other safety device.

- Exceptions to Lockout/Tagout

c) Hot tap operations.

Lockout or Tagout System Procedures:

- Airport Notification: Notify the Airport Project Manager that the Contractor's lockout or tagout system, which has been reviewed and approved by the Airport, is going to be utilized and the reasons why. Notifications are to be made through the general Contractor to the Airport. Document which Contractor personnel are to be authorized to perform lockout/tagout, and which areas are affected by the lockout/tagout.
- Preparation: Locate all energy sources that need to be isolated.
- Equipment Shutdown: If the equipment is operating, Contractor shall receive prior Airport approval and shut it down by the normal stopping procedure.
- Restoring Locked Equipment to Normal Operation: After the servicing and/or maintenance is complete, check the machines or equipment to ensure that no one is exposed prior to energizing the system.

The Contractor shall be responsible for complying with all applicable laws and regulations at all times.

If the Contractor requires access to a restricted mechanical/electrical room, the Contractor shall contact the Airport Police office for the required keys. The Contractor shall contact the Airport Communications Center at 616-233-6055 for access after hours.

1.9 HAZARDOUS MATERIALS

The Contractor shall consult with the Airport Project Manager as to the location of any hazardous materials in the work area. The Contractor shall exercise care and diligence in maintaining applicable safety precautions in executing the work in areas containing hazardous material.

Contractors and subcontractors shall comply with all regulations, codes, and laws for the necessary protection of their workers and for the protection of the Airport, Tenants, and the public when making alterations to work in areas containing hazardous material.

If the Contractor or subcontractor perceives that a material may be hazardous and will affect the work, Contractor shall notify the Airport Communication Center or the Facilities Department. The Airport will take appropriate action as necessary.

1.10 HOT WORK PERMITS

The Contractor shall submit a HOT WORK PERMIT to Aircraft Rescue and Firefighting (ARFF) prior to any activity within the scope of work this is performed which could provide the risk of intense heat or fire. This includes any activity that requires the use of an open flame, creates a spark or use of tool that uses powder actuated devices. Examples of these activities are welding, metal or pipe cutting, the use of open flames for demolition and the use of powder activated devices.

The Contractor shall follow all requirements in GFIAA's current Hot Work Permit Safety Standard, available from GFIAA Engineering upon request.

1.11 CONFINED SPACE ENTRY REGULATIONS:

The Contractor shall comply with applicable portions of Federal Regulation 29 CFR S 1910.146 and Michigan laws regarding employee entrance into confined spaces on this project.

Confined Space – A space which by design has limited openings for entry and exit, unfavorable natural ventilation and is not intended for permanent employee occupancy. Included in these are tanks, tunnels, process vessels, manholes, boilers, ventilation and exhaust ducts, large pipe lines, excavations, manholes, catch basis, drainage structures etc.

1.12 USE OF FIRE HYDRANTS

Contractor's use of fire hydrants as a water supply –

- Yellow fire hydrants on airport property are owned by the City of Grand Rapids Water System. Use of the hydrants for construction purposes is permitted according to Grand Rapids rules. A fire hydrant use permit and connections must be obtained from at Grand Rapids Water System Field Operations prior to use.
- On airport property only yellow fire hydrants may be tapped by the Contractor.

The Contractor is responsible for all fees and penalties associated with use of Grand Rapids hydrants.

1.13 MINIMUM STANDARDS REQUIREMENT

All projects being designed and constructed on behalf of GFIAA or a tenant of GFIAA are to comply with applicable standards found in the following documents, all available at the GFIAA Documents & Forms website https://www.grr.org/documents-forms.

- Airport Rules and Regulations
- Tenant Development Standards
- Minimum Standards Policy

END OF SECTION 01 14 01

SECTION 01 21 00
ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Contingency allowances.

2. Excavation

C. Related Requirements:

1. Section 01 26 00 "Contract Modification Procedures" for procedures for submitting and handling Change Orders Section 01 26 00 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Section 01 40 00 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.3 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.5 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's bond shall account for the total project cost, inclusive of contingencies. Costs for products and equipment ordered by Owner under the contingency allowance shall allow the following mark-ups for Contractor’s overhead and profit:

1. General Contractor’s self-performed work: 5%
2. Subcontractor’s self-performed work: 5%
3. General Contractor’s mark-up of Subcontractor’s work: 0%

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.8 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging third-party testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of testing and inspection services not specifically required by a third party in the Contract Documents are Contractor responsibilities and are not included in the allowance.

1.9 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

Allowance No. 1 – Over Excavation Allowance: **$75,000**

Amount equal to a lump sum amount of seventy-five thousand dollars ($75,000.00), to be included within the Base Bid, contractor shall assume over-excavation and off-site disposal of 50 additional cubic yards of unsuitable soil beyond identified excavation depths, as well as 50 cubic yards of suitable fill, to be included within the Base Bid.

Allowance No. 2 – Security for Spoils Allowance: **$20,000**

Amount equal to a lump sum amount of twenty thousand dollars ($20,000.00), to be included within the Base Bid, for security services at spoils area gate, as specified in C-106 “Safety, Security, and Maintenance of Traffic” and on the plans. The allowance shall be used to reimburse the contractor for actual costs incurred to reimburse the airports security contractor for gate guard services. The cost for the allowance shall be included in the base bid cost for the project.

END OF SECTION 01 21 00

SECTION 01 23 00
ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. **Alternate No. 1**: Maintenance Building Overhead Door Replacement

1. Base Bid: No work on the western and southern Maintenance Building overhead doors.

2. Alternate No.1: Demolish thirteen existing overhead doors in the Maintenance Building. Provide and install thirteen overhead doors. Work timing to be coordinated with Maintenance Staff.

END OF SECTION 01 23 00

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Document 00 26 00 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
2. Section 01 21 00 "Allowances" for products selected under an allowance.
3. Section 01 23 00 "Alternates" for products selected under an alternate.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form provided in Project Manual.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

    a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
    b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Substitution request is fully documented and properly submitted.
e. Requested substitution will not adversely affect Contractor's construction schedule.
f. Requested substitution has received necessary approvals of authorities having jurisdiction.
g. Requested substitution is compatible with other portions of the Work.
h. Requested substitution has been coordinated with other portions of the Work.
i. Requested substitution provides specified warranty.
j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 01 31 00 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to the Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

END OF SECTION 01 26 00

PROPOSAL
WORKSHEET DETAIL

Project:

Change Order Request Number: _____

From: _____

Re: _____

Date: _____

Proposal Request Number: _____

A/E Project Number: _____

SHADED AREAS FOR A/E USE

ADDITIONS

	Ref. No.	Item Description	Quantity		UNIT PRICES Materials		UNIT PRICES Labor		SUBTOTALS Materials		SUBTOTALS Labor		TOTAL	
1									$ -		$ -		$ -	
2									$ -		$ -		$ -	
3									$ -		$ -		$ -	
4									$ -		$ -		$ -	
		Subtotal (Enter this number on Worksheet Summary.)			$ -		$ -		$ -		$ -		$ -	

DEDUCTIONS

	Ref. No.	Item Description	Quantity		UNIT PRICES Materials		UNIT PRICES Labor		SUBTOTALS Materials		SUBTOTALS Labor		TOTAL	
1									$ -		$ -		$ -	
2									$ -		$ -		$ -	
3									$ -		$ -		$ -	
4									$ -		$ -		$ -	
		Subtotal (Enter this number on Worksheet Summary.)			$ -		$ -		$ -		$ -		$ -	

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PROPOSAL
WORKSHEET SUMMARY

Project:

Change Order Request Number: _____

From: _____

Re: _____

Date: _____

Proposal Request Number: _____

A/E Project Number: 1761.4482.50

Complete and attach Proposal Worksheet Detail for each element of Work. Enter Worksheet Information below.

ADDITIONS:

	Sheet	Description	Material	Labor	Subtotal
1					$ -
2					$ -
3					$ -
4					$ -
5					$ -
6					$ -
7					$ -
		Subtotal	$ -	$ -	$ -

DEDUCTIONS:

	Sheet	Description	Material	Labor	Subtotal
1					$ -
2					$ -
3					$ -
4					$ -
5					$ -
6					$ -
7					$ -
		Subtotal	$ -	$ -	$ -

	Subcontractor's Net:	
	Subcontractor's OH&P 5%:	
(Not applicable for Allowance Adjustments)	Subcontractor's Bond:	
	Subcontractor's Total:	$ -
	Subcontractor's Net:	
	Contractor's OH&P 10%:	
(Not applicable for Allowance Adjustments)	Contractor's Bond:	
	Insurance:	
	Tax:	
	WORKSHEET TOTAL:	$ -

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Document 00 43 73 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
2. Section 01 21 00 "Allowances" for procedural requirements governing the handling and processing of allowances.
3. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than 7 days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 01 10 00 "Summary."

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Owner's name.
    c. Owner's Project number.
    d. Name of Architect.
    e. Architect's Project number.
    f. Contractor's name and address.
    g. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

    a. Related Specification Section or division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

        1) Labor.
        2) Materials.
        3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of 5 percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site.

6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
11. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling 5 percent of the Contract Sum and subcontract amount.
12. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Application for Payment to Architect by the 15th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

1. Submit draft copy of Application for Payment 7 days prior to due date for review by Architect.

D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.

E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

G. Transmittal: Submit 1 signed and notarized original copy of each Application for Payment to the Architect by email. Include waivers of lien and similar attachments if required.

1. Transmit with a transmittal form listing attachments and recording appropriate information about application.

H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Sustainable design action plans, including preliminary project materials cost data.
7. Schedule of unit prices.
8. Submittal schedule (preliminary if not final).
9. List of Contractor's staff assignments.
10. List of Contractor's principal consultants.
11. Copies of building permits.
12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
13. Initial progress report.
14. Report of preconstruction conference.
15. Certificates of insurance and insurance policies.
16. Performance and payment bonds.
17. Data needed to acquire Owner's insurance.

J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 01 77 00 "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.

2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.
4. Section 01 91 13 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Architect.
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. **Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.**
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow 7 days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within 7 days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Where applicable, upon executed release forms, Digital data files of Architect's CAD drawings will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Revit.
4. Contractor and subcontractors shall execute a data licensing agreement in the form of Agreement included in Project Manual.

B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 7 days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, and Architect, within 3 days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Use of web-based Project software.

h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.
k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Sustainable design requirements.
o. Preparation of Record Documents.
p. Use of the premises.
q. Work restrictions.
r. Working hours.
s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Parking availability.
y. Office, work, and storage areas.
z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.
cc. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.

k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of Record Documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Procedures for completing and archiving web-based Project software site data files.
d. Submittal of written warranties.
e. Requirements for completing sustainable design documentation.
f. Requirements for preparing operations and maintenance data.
g. Requirements for delivery of material samples, attic stock, and spare parts.

h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: General Contractor to conduct Owner/Architect progress meetings at two-week intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Status of sustainable design documentation.
6) Deliveries.
7) Off-site fabrication.
8) Access.
9) Site use.
10) Temporary facilities and controls.

11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Status of RFIs.
16) Status of Proposal Requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each contractor present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of BIM component conflicts.

4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site use.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Status of RFIs.
15) Proposal Requests.
16) Change Orders.
17) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

EXHIBIT 01 31 00 A
1 of 2

ELECTRONIC FILE TRANSFER REQUEST

Name:

Re: Request for Electronic Files
Project: SRE Building Expansion
Electronic files requested: _____

At your request, C&S Engineers, LLC "C&S", will provide ("You") with an electronic copy of the above files, for Your convenience and use in the construction of the above project, in consideration of and subject to the following terms and conditions.

1. The electronic files are in a format and were created with software licensed to and operated by C&S, or C&S subcontractors, or other third parties. C&S makes no warranty, express or implied, that the electronic files will be compatible with, or will not affect or damage, other hardware and software. You, as well as any subsequent direct or indirect transferee or user, takes the electronic files subject to, and assumes, the entire risk of damages arising from the use, copying, transfer and any other use whatsoever of the electronic files.

2. You, on behalf of Yourself and any subsequent direct or indirect transferee receiving, opening, using or copying the electronic files, are responsible for, and You release and agree to indemnify and hold harmless C&S from and against all claims, damages, liabilities, expenses and costs, including but not limited to all attorney fees, arising out of or resulting from Your transfer, use, reliance upon, opening, copying, modification, sharing, or forwarding of the electronic files.

3. You acknowledge and agree that the electronic files are not construction documents. Differences may exist between these electronic documents and hard-copy construction documents or actual construction in place. The electronic files are provided for Your convenience only and C&S makes no warranty, express or implied, that the electronic files are suitable for your intended purposes. You, or any direct or indirect assignee or transferee from You, is solely responsible for determining if there are any discrepancies between the printed construction documents and files, on the one hand, and these electronic files. The use of the electronic files does not relieve You, or any contractor or subcontractor, of its duty, without limitation, to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions, and coordinate your work with any consultant, contractor or subcontractor for the project.

4. Subject to all terms, conditions and considerations recited herein, You may make fair use of the electronic files in connection with the construction of the above identified project only. Fair use of such electronic files does not include copying, reproducing, abridging or modifying the electronic files for use in any other project or for any other purpose.

5. You, on Your own behalf and, without limitation, on behalf of any contractor, subcontractor or consultant obtaining directly or indirectly from You originals or copies of the electronic files, agree to maintain reasonable control over the distribution of copies and reproduction of the electronic files, and to inform any party provided with the electronic files of the terms and conditions herein, including providing a copy of this letter agreement to each such transferee.

6. Because information, drawings, specifications and data contained in the electronic files can and may be modified, deteriorate or be corrupted, whether intentionally or inadvertently, C&S reserves the right to remove any indicia of origin, creation and ownership. Any such removal shall not be construed as abandonment of any right, title or interest in the electronic files.

7. This letter agreement is governed by the laws of the State of Michigan, and supersedes and integrates all negotiations between You and C&S with regard to C&S providing the electronic files to You. This letter agreement may not be modified or revoked except by the express written agreement of both You and C&S.

8. The service fee for C&S providing the electronic files is $_____. C&S's provision of the electronic files to You is not intended by You or C&S to be a sale, and shall not be construed as a sale by C&S to You or to any other person.

9. This letter agreement may be executed in counterparts, and does not require signatures by all parties on a single document. An exchange of electronic messages may be used to verify the agreement of the parties in lieu of or in supplementation of signed hard copy documents.

10. The scope of this letter agreement is limited to C&S providing the above electronic files to You. Nothing in this letter agreement shall be construed to change or modify any basic construction agreements, subcontract agreements, or other agreements.

11. By signing and indicating agreement to the terms of this letter agreement, each of the individual signatories warrants that he or she is authorized to bind his or her respective principal to the terms and conditions herein.

By:_____	By:_____
(Signature)	(Signature)
Print Name:_____	Print Name: _____
Date:_____	Date: _____

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
4. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
5. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
6. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
7. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Prepare submittals as PDF package and transmit to Architect by sending via email or web-based software. Include PDF transmittal form. Include information in email subject line as requested by Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams that show factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.

f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples at the job site for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Identification: Permanently attach label on unexposed side of Samples that includes the following:

a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

2. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

E. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

1.7 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and 3 paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.

2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00

EXHIBIT 01 33 00A

DIVISION 2 THROUGH 33 SUBCONTRACTORS AND MANUFACTURERS LIST

Project:
NAME OF BIDDER_____DATE_____

ADDRESS: _____PHONE_____

BY_____ _____
Printed Signature

The undersigned hereby submits the following Subcontractors and Manufacturers list, which becomes a part of the undersigned Contract proposal. Subcontractor purchased material, equipment, and labor shall be under the direct management of the Prime Contractor. If dual listing of manufacturers or subcontractors is herein made, it is understood the Architect/Engineer (not the Contractor) will select the manufacturer or subcontractor of his choice.

Specification Section	Description	Subcontractor	Manufacturer
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2.			
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SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:

1. Section 01 21 00 "Allowances" for testing and inspection allowances.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of 5 previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Full-size physical assemblies that are constructed as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements consisting of multiple products, assemblies, and subassemblies, with cutaways enabling inspection of concealed portions of the Work.

a. Include each system, assembly, component, and part of the exterior wall and roof to be constructed for the Project. Colors of components shall be those selected by the Architect for use in the Project.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 ACTION SUBMITTALS

A. Mockup Shop Drawings: For integrated exterior mockups.

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than 5 days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged in the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.

4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. Build laboratory mockups at testing facility, using personnel, products, and methods of construction indicated for the completed Work.
6. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
7. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow 7 days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.

1. Coordinate construction of the mockup to allow observation of air barrier installation, flashings, air barrier integration with fenestration systems, and other portions of the building air/moisture barrier and drainage assemblies, prior to installation of veneer, cladding elements, and other components that will obscure the work.

1.11 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services as called out in the technical specifications.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Payment for these services will be made from testing and inspection allowances specified in Section 01 21 00 "Allowances," as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements as called out in the technical specifications.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.12 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 40 00

SECTION 01 42 00
REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if

bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.

19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASSP - American Society of Safety Professionals (The); www.assp.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AVIXA - Audiovisual and Integrated Experience Association; (Formerly: Infocomm International); www.soundandcommunications.com.
38. AWEA - American Wind Energy Association; www.awea.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
50. CDA - Copper Development Association; www.copper.org.
51. CE - Conformite Europeenne; http://ec.europa.eu/growth/single-market/ce-marking/.
52. CEA - Canadian Electricity Association; www.electricity.ca.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.

59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.compositepanel.org.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csa-group.org.
65. CSI - Construction Specifications Institute (The); www.csiresources.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTA - Consumer Technology Association; www.cta.tech.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.coolingtechnology.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHA - Decorative Hardwoods Association; (Formerly: Hardwood Plywood & Veneer Association); www.decorativehardwoods.org.
72. DHI - Door and Hardware Institute; www.dhi.org.
73. ECA - Electronic Components Association; (See ECIA).
74. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
75. ECIA - Electronic Components Industry Association; www.eciaonline.org.
76. EIA - Electronic Industries Alliance; (See TIA).
77. EIMA - EIFS Industry Members Association; www.eima.com.
78. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
79. EOS/ESD Association; (Electrostatic Discharge Association); www.esda.org.
80. ESTA - Entertainment Services and Technology Association; (See PLASA).
81. ETL - Intertek (See Intertek); www.intertek.com.
82. EVO - Efficiency Valuation Organization; www.evo-world.org.
83. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
84. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
85. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
86. FM Approvals - FM Approvals LLC; www.fmglobal.com.
87. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
88. FRSA - Florida Roofing, Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
89. FSA - Fluid Sealing Association; www.fluidsealing.com.
90. FSC - Forest Stewardship Council U.S.; www.fscus.org.
91. GA - Gypsum Association; www.gypsum.org.
92. GANA - Glass Association of North America; (See NGA).
93. GS - Green Seal; www.greenseal.org.
94. HI - Hydraulic Institute; www.pumps.org.
95. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
96. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
97. HPVA - Hardwood Plywood & Veneer Association; (See DHA).
98. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
99. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
100. IAS - International Accreditation Service; www.iasonline.org.
101. ICBO - International Conference of Building Officials; (See ICC).

102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
113. II - Infocomm International; (See AVIXA).
114. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
115. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
116. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
117. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
118. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
119. ISO - International Organization for Standardization; www.iso.org.
120. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
121. ITU - International Telecommunication Union; www.itu.int/home.
122. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
123. LMA - Laminating Materials Association; (See CPA).
124. LPI - Lightning Protection Institute; www.lightning.org.
125. MBMA - Metal Building Manufacturers Association; www.mbma.com.
126. MCA - Metal Construction Association; www.metalconstruction.org.
127. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
128. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
129. MHIA - Material Handling Industry of America; www.mhia.org.
130. MIA - Marble Institute of America; (See NSI).
131. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
132. MPI - Master Painters Institute; www.paintinfo.com.
133. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
134. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
135. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
136. NADCA - National Air Duct Cleaners Association; www.nadca.com.
137. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
138. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
139. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
140. NBI - New Buildings Institute; www.newbuildings.org.
141. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.

142. NCMA - National Concrete Masonry Association; www.ncma.org.
143. NEBB - National Environmental Balancing Bureau; www.nebb.org.
144. NECA - National Electrical Contractors Association; www.necanet.org.
145. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
146. NEMA - National Electrical Manufacturers Association; www.nema.org.
147. NETA - InterNational Electrical Testing Association; www.netaworld.org.
148. NFHS - National Federation of State High School Associations; www.nfhs.org.
149. NFPA - National Fire Protection Association; www.nfpa.org.
150. NFPA - NFPA International; (See NFPA).
151. NFRC - National Fenestration Rating Council; www.nfrc.org.
152. NGA - National Glass Association (The); (Formerly: Glass Association of North America); www.glass.org.
153. NHLA - National Hardwood Lumber Association; www.nhla.com.
154. NLGA - National Lumber Grades Authority; www.nlga.org.
155. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
156. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
157. NRCA - National Roofing Contractors Association; www.nrca.net.
158. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
159. NSF - NSF International; www.nsf.org.
160. NSI - National Stone Institute; (Formerly: Marble Institute of America); www.naturalstoneinstitute.org.
161. NSPE - National Society of Professional Engineers; www.nspe.org.
162. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
163. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
164. NWFA - National Wood Flooring Association; www.nwfa.org.
165. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
166. PDI - Plumbing & Drainage Institute; www.pdionline.org.
167. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
168. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
169. RFCI - Resilient Floor Covering Institute; www.rfci.com.
170. RIS - Redwood Inspection Service; www.redwoodinspection.com.
171. SAE - SAE International; www.sae.org.
172. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
173. SDI - Steel Deck Institute; www.sdi.org.
174. SDI - Steel Door Institute; www.steeldoor.org.
175. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
176. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
177. SIA - Security Industry Association; www.siaonline.org.
178. SJI - Steel Joist Institute; www.steeljoist.org.
179. SMA - Screen Manufacturers Association; www.smainfo.org.
180. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
181. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
182. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
183. SPIB - Southern Pine Inspection Bureau; www.spib.org.

184. SPRI - Single Ply Roofing Industry; www.spri.org.
185. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
186. SSINA - Specialty Steel Industry of North America; www.ssina.com.
187. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
188. STI - Steel Tank Institute; www.steeltank.com.
189. SWI - Steel Window Institute; www.steelwindows.com.
190. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
191. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
192. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
193. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
194. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
195. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
196. TMS - The Masonry Society; www.masonrysociety.org.
197. TPI - Truss Plate Institute; www.tpinst.org.
198. TPI - Turfgrass Producers International; www.turfgrasssod.org.
199. TRI - Tile Roofing Institute; www.tileroofing.org.
200. UL - Underwriters Laboratories Inc.; www.ul.com.
201. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
202. USAV - USA Volleyball; www.usavolleyball.org.
203. USGBC - U.S. Green Building Council; www.usgbc.org.
204. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
205. WA - Wallcoverings Association; www.wallcoverings.org.
206. WASTEC - Waste Equipment Technology Association; www.wastec.org.
207. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
208. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
209. WDMA - Window & Door Manufacturers Association; www.wdma.com.
210. WI - Woodwork Institute; www.wicnet.org.
211. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.govinfo.gov.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 014339
MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior mockups.
2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
3. Review locations and extent of mockups.
4. Review testing procedures to be performed on mockups.
5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups.

1. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.

1.5 QUALITY ASSURANCE

A. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.

B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
3. Demonstrate the proposed range of aesthetic effects and workmanship.

C. Notifications:

1. Notify Architect and Construction Manager, 14 days in advance of the dates and times when mockups will be tested.
2. Allow seven days for initial review and each re-review of each mockup.

D. Approval: Obtain Architect's and Construction Manager's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups as indicated on Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

C. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

D. The Work of integrated exterior mockups includes, but is not limited to, the following:

1. Precast architectural concrete.
2. Masonry veneer.
3. Cold-formed metal framing and sheathing.
4. Air and weather barriers.
5. Thermal insulation.
6. Through-wall flashing.
7. Flashing and sheet metal trim.
8. Joint sealants.
9. Aluminum windows.
10. Glazing.

E. Retain approved mockups constructed in place. Incorporate fully into the Work.

PART 3 - EXECUTION

END OF SECTION 014339

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations, as applicable.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations, as applicable.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations, as applicable.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation.

G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service underground unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Utilize designated area within existing building for temporary field offices.
3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 31 20 00 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 32 12 16 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Provide temporary onsite parking areas for construction personnel.

F. Storage and Staging: Use designated areas of Project site for storage and staging needs.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

H. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.

I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."

J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 01 10 00 "Summary."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 73 00
EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.

B. Related Requirements:

1. Section 01 10 00 "Summary" for coordination of Owner-furnished products and limits on use of Project site.
2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 PREINSTALLATION MEETINGS

A. Layout Conference: Conduct conference at Project site.

1. Prior to establishing layout of new perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend.
2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
3. Review requirements for including layouts on Shop Drawings and other submittals.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

2.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

2.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Lay out the Work using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

2.4 FIELD ENGINEERING

A. Identification: Identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of 2 permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

2.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

G. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

2.6 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

2.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

2.8 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 01 29 00 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
3. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Section 01 79 00 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 01 29 00 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Page number.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit PDF by email to Architect.

E. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural

weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

    1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.

q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 01 77 00

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

B. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

D. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in

manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.7 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

1.8 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents.

Identify data applicable to the Work and delete references to information not applicable.

a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 01 73 00 "Execution" for final property survey.
2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Final Submittal:

1) Submit PDF electronic files of scanned Record Prints and 1 set of file prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

    a. See Section 01 31 00 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit 2 copies within 7 days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF format required for operation and maintenance manuals specified in Section 01 78 23 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.

f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:

a. Emergency manuals.
b. Systems and equipment operation manuals.
c. Systems and equipment maintenance manuals.
d. Product maintenance manuals.
e. Project Record Documents.
f. Identification systems.
g. Warranties and bonds.
h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

    a. Diagnostic instructions.
    b. Test and inspection procedures.

7. Maintenance: Include the following:

    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning.
    e. Procedures for preventive maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.

1.8 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."

1.9 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 79 00

Item C-102 Temporary Air and Water Pollution, Soil Erosion, and Siltation Control

DESCRIPTION

102-1. This item shall consist of temporary control measures as shown on the plans or as ordered by the Resident Project Representative (RPR) during the life of a contract to control pollution of air and water, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

Temporary erosion control shall be in accordance with the approved erosion control plan; the approved Construction Safety and Phasing Plan (CSPP) and AC 150/5370-2, *Operational Safety on Airports During Construction*. The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be designed, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

MATERIALS

102-2.1 Grass. Not Used

102-2.2 Mulches. Not Used

102-2.3 Fertilizer. Not Used

102-2.4 Slope drains. Not Used

102-2.5 Silt fence. Silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life. Silt fence shall meet the requirements of ASTM D6461.

102-2.6 Other. All other materials shall meet commercial grade standards and shall be approved by the RPR before being incorporated into the project.

CONSTRUCTION REQUIREMENTS

102-3.1 General. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply. The RPR shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

102-3.2 Schedule. Prior to the start of construction, the Contractor shall submit schedules in accordance with the approved Construction Safety and Phasing Plan (CSPP) and the plans for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the RPR.

102-3.3 Construction details. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the plans and approved CSPP. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion may be a problem, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately if project conditions permit. Temporary erosion control measures are required if permanent measures cannot immediately follow grading operations. The RPR shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the RPR.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the RPR. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the RPR, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The RPR may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be maintained by the Contractor during the construction period.

Provide temporary structures whenever construction equipment must cross watercourses at frequent intervals. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

102-3.4 Installation, maintenance and removal of silt fence. Silt fences shall extend a minimum of 16 inches (41 cm) and a maximum of 34 inches (86 cm) above the ground surface. Posts shall be set no more than 10 feet (3 m) on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12-inch (300-mm) overlap and securely sealed. A trench shall be excavated approximately 4 inches (100 mm) deep by 4 inches (100 mm) wide on the upslope side of the silt fence. The trench shall be backfilled and the soil compacted over the silt fence fabric. The Contractor shall

remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the RPR.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5200-33 *Hazardous Wildlife Attractants on or Near Airports*

AC 150/5370-2 *Operational Safety on Airports During Construction*

ASTM International (ASTM)

ASTM D6461 *Standard Specification for Silt Fence Materials*

United States Department of Agriculture (USDA)

FAA/USDA Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF ITEM C-102

Item C-105 Mobilization

105-1 Description. This item of work shall consist of, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.

105-2 Mobilization limit. Mobilization shall be limited to 10percent of the total project cost.

105-3 Posted notices. Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster "Equal Employment Opportunity is the Law" in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL "Notice to All Employees" Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

105-4 Engineer/RPR field office. The Contractor shall provide dedicated space for the use of the field RPR and inspectors, as a field office for the duration of the project. This space shall be located conveniently near the construction and shall be separate from any space used by the Contractor. The Contractor shall furnish water, sanitary facilities, heat, air conditioning, and electricity in accordance with local building codes.

105-4.1 Field Office. The Contractor shall supply for the Engineer's use, a building or mobile trailer which shall be erected at the location shown on the Contract Drawings and shall be separate from any building used by the Contractor. The field office, equipment and all appurtenances shall be onsite, installed and operational at least 7 days prior to commencement of construction, and shall remain in place for a period of 30 days after the date of final acceptance of the project. The Contractor shall maintain all facilities and furnished equipment in good working condition.

The field office shall have a minimum ceiling height of 7 feet and shall be provided with six weather proof windows and two weatherproof doors, each equipped with adequate locking devices. Each window shall have a minimum area of 8 square feet, shall be screened and of a type that will open and close to provide adequate ventilation.

The field office shall have a minimum of 325 square feet of floor space. The field office shall be partitioned to provide two rooms with an adjoining door. The smaller room shall be not less than 95 square feet in floor area and shall contain two windows.

Lighting shall consist of electric non-glare type luminaries that provide a minimum level of 93 foot-candles at desk height level.

Heating and cooling units shall be capable of maintaining an ambient air temperature of 70 degrees F, +/- 5 degrees.

Hot and cold running water shall be provided. The water may be provided from a municipal water line, or from potable bottled water. Potable bottled water shall utilize a dispensing unit capable of providing hot and cold water.

The field office shall have a separately enclosed room, properly ventilated and complying with applicable sanitary codes with a flush-type toilet. The Contractor shall provide all lavatory amenities, necessary paper and soap products, and hot and cold running water.

The Contractor shall provide a parking area for 5 vehicles. The area shall be 45 feet wide by 18 feet long, and shall be paved, crushed stone, gravel or bank-run material.

Steps shall be installed at each door to the field office and shall include a hand rail. Steps shall meet the requirements of all applicable building, safety, and health regulations and laws. Portable steps, when used, shall be set level and shall be suitably anchored to the ground to prevent movement.

The office shall be cleaned at least once weekly, and at other times as directed by the Engineer.

The field office and site shall be maintained in good condition and appearance by the Contractor for the designated period, after which the field office, utilities and appurtenances shall be removed and the site restored to a condition equal to or better than original condition. The Contractor shall be responsible, until use and occupancy of the field office is relinquished by the Engineer, for any and all damage, direct or indirect, of whatever nature, occurring to the property of the Owner and Engineer, including the property of other employees of the Engineer assigned to the field office, which is kept in the field office. The responsibility of property shall include only those items used by appropriate personnel in the performance of project related work activities.

105-4.1 Office desk and chairs. The Contractor shall provide 3 office desks that are at least 2-1/2 feet by 5 feet each and 6 office chairs.

105-4.2 Drafting table and stools. The Contractor shall provide 2 drafting tables which are approximately 3 feet by 6 feet and 4 stools.

105-4.3 Office table. The Contractor shall provide an office table which is at least 3 feet by 6 feet.

105-4.4 Printer paper and ink cartridges. The Contractor shall provide a supply of 8-1/2 x 11 inch and 11 x 17 inch printer paper and spare printer ink cartridges in the field office. The supply shall be replenished as needed throughout the duration of the project.

105-4.5 Refrigerator. The Contractor shall provide a standard electric cold storage type refrigerator providing a minimum storage space of 3 cubic feet.

105-4.6 Vertical filing rack. The Contractor shall provide one vertical filing rack which is capable of holding 6 sets of plans.

105-4.7 First aid kit. The Contractor shall provide a first aid kit properly stocked with appropriate first aid supplies.

105-4.8 Fire extinguishers. The Contractor shall provide one fire extinguisher per room. The fire extinguisher shall be a non-toxic dry chemical, fire extinguisher meeting Underwriters Laboratories, Inc., approval for Class A, Class B and Class C fires with a minimum rating of 2A:10B:10C.

105-4.9 Tack boards. The Contractor shall provide a cork tack board mounted on a wall in each room. The tack board shall be a minimum of 2 feet high by 4 feet wide.

105-4.10 Waste paper baskets. The Contractor shall provide a metal waste basket in each room.

105-4.11 Internet Access. A secured wired or wireless network with ability for printing and scanning documents and access to high speed internet for multiple computers and/or devices available from the start of the project for the project duration. A minimum download speed of 25 Mbps is required for the accepted internet connection. Connection type shall be approved by the Engineer.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Office of Federal Contract Compliance Programs (OFCCP)

Executive Order 11246, as amended

EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

United States Department of Labor, Wage and Hour Division (WHD)

WH 1321 – Employee Rights under the Davis-Bacon Act Poster

END OF ITEM C-105

Item C-106 Safety, Security and Maintenance of Traffic

DESCRIPTION

106-1.1 General. This work shall consist of maintaining aircraft and vehicular traffic and protecting the public from damage to person and property within the limits of and for the duration of the Contract, and as specified in the Construction Safety and Phasing Plan, Appendix A to Section 70.

Contractor is responsible for maintenance and repair of these items, regardless of cause of damage, until the project is accepted.

The following items are specifically included without limiting the generality implied by these Specifications and the Contract Drawings. Contractor is responsible for maintenance and repair of these items, regardless of cause of damage, until the project is accepted.

- Restoration of all surfaces disturbed as a result of the Contractor's Operations which are not otherwise paid for.
- Installation, maintenance, repair and removal of temporary access roads and maintenance and repair of existing access roads, including dust control measures.
- Installation, maintenance, repair and removal of temporary barricades, barricade lights, barricade flags, warning signs and hazard markings.
- Installation, maintenance, repair and removal of temporary lights and lighting circuits. Temporary above ground lighting cables shall be delineated with stakes and flagging in turf areas and barricades in paved areas.

The Owner will be responsible for issuing notification to patrons of the parking lot for upcoming work based on the Contractor's schedule. Contractor shall be responsible for moving parked vehicles which interfere with the work of this Contract. Vehicles shall be moved to a location designated by the Owner during construction. Damage to vehicles caused by the Contractor's operations shall be repaired by the Contractor at no expense to the Owner or vehicle owner.

END OF ITEM C-106

Item P-101 Preparation/Removal of Existing Pavements

DESCRIPTION

101-1 This item shall consist of preparation of existing pavement surfaces for overlay, surface treatments, removal of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with these specifications and the applicable plans.

EQUIPMENT AND MATERIALS

101-2 All equipment and materials shall be specified here and in the following paragraphs or approved by the Resident Project Representative (RPR). The equipment shall not cause damage to the pavement to remain in place.

CONSTRUCTION

101-3.1 Removal of existing pavement.

The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

a. Concrete pavement removal. Full depth saw cuts shall be made perpendicular to the slab surface. The Contractor shall saw through the full depth of the slab including any dowels at the joint, removing the pavement and installing new dowels as shown on the plans and per the specifications. Where the perimeter of the removal limits is not located on the joint and there are no dowels present, the perimeter shall be saw cut the full depth of the pavement. The pavement inside the saw cut shall be removed by methods which will not cause distress in the pavement which is to remain in place. Concrete slabs that are damaged by under breaking shall be repaired or removed and replaced as directed by the RPR.

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Spall and underbreak repair shall be in accordance with the plans. Any underlaying material that is to remain in place, shall be recompacted and/or replaced as shown on the plans. Adjacent areas damaged during repair shall be repaired or replaced at the Contractor's expense.

b. Asphalt pavement removal. Asphalt pavement to be removed shall be cut to the full depth of the asphalt pavement around the perimeter of the area to be removed.

c. Repair or removal of Base, Subbase, and/or Subgrade. All failed material including surface, base course, subbase course, and subgrade shall be removed and repaired as shown on the plans or as directed by the RPR. Materials and methods of construction shall comply with the applicable sections of these specifications. Any damage caused by Contractor's removal process shall be repaired at the Contractor's expense.

101-3.2 Preparation of joints and cracks prior to overlay/surface treatment. Not Used

101-3.3 Removal of Foreign Substances/contaminates prior to overlay. Not Used

101-3.4 Concrete spall or failed asphaltic concrete pavement repair.

a. Repair of concrete spalls in areas to be overlaid with asphalt. Not Used

b. Asphalt pavement repair. Not Used

101-3.5 Cold milling. Milling shall be performed with a power-operated milling machine or grinder, capable of producing a uniform finished surface. The milling machine or grinder shall operate without tearing or gouging the underlaying surface. The milling machine or grinder shall be equipped with grade and slope controls, and a positive means of dust control. All millings shall be removed and disposed off Airport property. If the Contractor mills or grinds deeper or wider than the plans specify, the Contractor shall replace the material removed with new material at the Contractor's Expense.

a. Patching. The milling machine shall be capable of cutting a vertical edge without chipping or spalling the edges of the remaining pavement and it shall have a positive method of controlling the depth of cut. The RPR shall layout the area to be milled with a straightedge in increments of 1-foot (30 cm) widths. The area to be milled shall cover only the failed area. Any excessive area that is milled because the Contractor doesn't have the appropriate milling machine, or areas that are damaged because of his negligence, shall be repaired by the Contractor at the Contractor's Expense.

b. Profiling, grade correction, or surface correction. The milling machine shall have a minimum width of 7 feet and it shall be equipped with electronic grade control devices that will cut the surface to the grade specified. The tolerances shall be maintained within +0 inch and -1/4 inch (+0 mm and -6mm) of the specified grade. The machine must cut vertical edges and have a positive method of dust control. The machine must have the ability to remove the millings or cuttings from the pavement and load them into a truck. All millings shall be removed and disposed of off the airport.

c. Clean-up. The Contractor shall sweep the milled surface daily and immediately after the milling until all residual materials are removed from the pavement surface. Prior to paving, the Contractor shall wet down the milled pavement and thoroughly sweep and/or blow the surface to remove loose residual material. Waste materials shall be collected and removed from the pavement surface and adjacent areas by sweeping or vacuuming. Waste materials shall be removed and disposed off Airport property .

101-3.6. Preparation of asphalt pavement surfaces prior to surface treatment. Not Used

101-3.7 Maintenance. The Contractor shall perform all maintenance work necessary to keep the pavement in a satisfactory condition until the full section is complete and accepted by the RPR. The surface shall be kept clean and free from foreign material. The pavement shall be properly drained at all times. If cleaning is necessary or if the pavement becomes disturbed, any work repairs necessary shall be performed at the Contractor's expense.

101-3.8 Preparation of Joints in Rigid Pavement prior to resealing. Not Used

101-3.8.1 Removal of Existing Joint Sealant. All existing joint sealants will be removed by plowing or use of hand tools. Any remaining sealant and or debris will be removed by use of wire brushes or other tools as necessary. Resaw joints removing no more than 1/16 inch (2 mm) from each joint face. Immediately after sawing, flush out joint with water and other tools as necessary to completely remove the slurry.

101-3.8.2 Cleaning prior to sealing. Immediately before sealing, joints shall be cleaned by removing any remaining laitance and other foreign material. Allow sufficient time to dry out joints prior to sealing. Joint surfaces will be surface-dry prior to installation of sealant.

101-3.8.3 Joint sealant. Joint material and installation will be in accordance with Item P-605.

101-3.9 Preparation of Cracks in Flexible Pavement prior to sealing. Prior to application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound, moisture and other foreign matter. The Contractor shall demonstrate, in the presence of the RPR that the method used cleans the cracks and does not damage the pavement.

101-3.9.1 Preparation of Crack. Not Used

101-3.9.2 Removal of Existing Crack Sealant. Not Used

101-3.9.3 Crack Sealant. Not Used

101-3.9.4 Removal of Pipe and other Buried Structures.

a. **Removal of Existing Pipe Material.** Not Used
b. **Removal of Inlets/Manholes.** Not used.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5380-6	Guidelines and Procedures for Maintenance of Airport Pavements.

ASTM International (ASTM)

ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

END OF ITEM P-101

Item P-604 Compression Joint Seals for Concrete Pavements

DESCRIPTION

604-1.1 This item shall consist of preformed polychloroprene compression seals used for sealing joints of rigid pavements.

MATERIALS

604-2.1 Compression seals. Compression joint seal materials shall be a vulcanized elastomeric compound using polychloroprene as the only base polymer. The material and the manufactured seal shall conform to ASTM D2628

The joint seal shall be a labyrinth type seal. The uncompressed depth of the face of the compression seal (that is to be bonded to the joint wall) shall be greater than the uncompressed width of the seal, except that for seals one inch (25 mm) or greater in width, the depth need be only one inch (25 mm) or greater. The actual width of the uncompressed seal shall be as recommended by the joint seal manufacturer for the type and width of joints as shown on the plans. The tolerance on the seal shall be +1/8 inch or -1/16 inch **(**+3 mm or -2 mm)**,** below the top of the pavement surface or bottom of groove for grooved pavement.

The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the joint seal material delivered to the project. The COA shall be provided to and approved by the RPR before the material is installed. The furnishing of the vendor's certified test report shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided at the job site to protect materials from weather and maintain materials at temperatures recommended by the manufacturer.

Representative sample of joint seal material will be sampled and retained by the RPR for possible testing.

604-2.2 Lubricant/adhesive. Lubricant/adhesive used for the compression elastomeric joint seal shall be a one-component compound conforming to ASTM D2835.

CONSTRUCTION METHODS

604-3.1 Equipment. Machines, tools, and equipment used in the performance of the work required by this section shall be approved by the RPR before the work starts and shall be maintained by the Contractor in satisfactory condition at all times.

a. Joint cleaning equipment.

(**1) Concrete saw.** A self-propelled power saw with water-cooled diamond saw blades shall be provided for cutting joints to the depths and widths specified and for removing filler, existing old joint seal or other material embedded in the joints or adhered to the joint faces.

(2) Waterblasting equipment. Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, a wand with safety release cutoff controls, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary water resupply equipment shall be of sufficient capacity to permit continuous operations. The pumps, hoses, wand, and nozzle shall be of sufficient capacity to permit the cleaning of both walls of the joint and the pavement surface for a width of at least 1/2 inch (12 mm) on either side of the joint. The pump shall be capable of supplying a pressure of at least 3,000 psi (20.7 MPa). A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch (psi) (kPa) at which the equipment is operating.

(**3) Sandblasting equipment.** Sandblasting is not allowed.

b. Sealing equipment. Equipment used to install the compression seal shall place the compression seal to the prescribed depths within the specified tolerances without cutting, nicking, twisting, or otherwise damaging the seal. The equipment shall not stretch or compress the seal more than 2.0% longitudinally during installation. The machine shall be an automatic self-propelled joint seal application equipment and shall be engine powered. The machine shall include a reservoir for the lubricant/adhesive, a device for conveying the lubricant/adhesive in the proper quantities to the sides the preformed seal or the sidewalls of the joint, a reel capable of holding one full spool of compression seal, and a power-driven apparatus for feeding the joint seal through a compression device and inserting the seal into the joint. The equipment shall also include a guide to maintain the proper course along the joint being sealed. The machine shall at all times be operated by an experienced operator.

Hand operated joint seal application equipment may be used for localized areas and for projects less than 500 square yards (450 square meters). The equipment shall be a two-axle, four-wheel machine that includes means for compressing and inserting the compression seal into the joint and a reel capable of holding one full spool of compression seal material.

CONSTRUCTION METHODS

604-4.1 Environmental conditions. The ambient temperature and the pavement temperature within the joint wall shall be at least 35°F (2°C) and rising at the time of installation of the materials. Sealant application will not be permitted if moisture or any foreign material is observed in the joint.

604-4.2 Trial joint seal and lubricant/adhesive installation. Prior to the cleaning and sealing of the joints for the entire project, a control strip at least 200 feet (69 meters) long shall be prepared at a location designated by the RPR using the specified materials and the approved equipment, to demonstrate the materials and construction processes for joint preparation and sealing of all types of joints included in the project. No other joints shall be sealed until the test installation has been approved by the RPR.

If materials or installation do not meet requirements, the materials shall be removed, and the joints shall be cleaned and a new trial joint seal installation shall be performed at the Contractor's expense. The RPR approved trial section will be incorporated into the permanent work.

604-4.3 Preparation of joints. Immediately before installation of the compression joint seal, the joints shall be thoroughly cleaned to remove all laitance, filler, existing sealer, foreign material and protrusions of hardened concrete from the sides and upper edges of the joint space to be sealed. Cleaning shall extend along pavement surfaces at least 1/2 inch (12 mm) on either side of the joint. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left free of debris and water. Any irregularity in the joint face that would prevent uniform contact between the joint seal and the joint face shall be corrected prior to the installation of the joint seal.

a. Sawing. Joints shall be sawed to clean and to open them to the full specified width and depth. Immediately following the sawing operation, the joint faces and opening shall be thoroughly cleaned using a water jet to remove all saw cuttings or debris remaining on the faces or in the joint opening. Compression seal shall be installed within three (3) calendar days of the time the joint cavity is sawed. Depth of the joint cavity shall be in accordance with manufacturer's instructions. Submit printed copies of manufacturers' instructions 60 days prior to use on the project. The saw cut for the joint seal cavity shall at all locations be centered over the joint line. The nominal width of the sawed joint seal cavity shall be as follows; the actual width shall be within a tolerance of ±1/16 inch (2 mm):

(1) If a nominal 13/16 inch (21 mm) wide compression seal is furnished, the nominal width of the saw cut shall be 1/2 inches (12 mm) when the pavement temperature at the time of sawing is between 25 and 80°F. If the pavement temperature at the time of sawing is above this range, the nominal width of the saw cut shall be decreased 1/16 inch (2 mm). If the pavement temperature at the time of sawing is below this range, the nominal width of the saw cut shall be increased 1/16 inch (2 mm).

(2) If a nominal one inch (25 mm) wide compression seal is furnished, the nominal width of the saw cut shall be 9/16 inches (14 mm) when the pavement temperature at the time of sawing is between 25 and 140°F. If the pavement temperature at the time of sawing is above this range, the nominal width of the saw cut shall be decreased 1/16 inch (2 mm). If the pavement temperature at the time of sawing is below this range, the nominal width of the saw cut shall be increased 1/16 inch (2 mm).

(3) The pavement temperature shall be measured and recorded in the presence of the RPR. Measurement shall be made each day before commencing sawing and at any other time during the day when the temperature appears to be moving out of the allowable sawing range.

b. Waterblast cleaning. The concrete joint faces and pavement surfaces extending at least 1/2 inch (12 mm) from the joint edges shall be waterblasted clean. A multiple pass technique shall be used until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

c. Sandblast cleaning. Sandblast cleaning is not allowed.

d. Rate of progress. Cleaning of the joint faces shall be limited to the linear footage of joint that can be sealed during the same workday.

604-4.4 Installation of the compression seal.

a. Time of installation. Joints shall be sealed within 3 calendar days of sawing the joint seal cavity and the final cleaning of the joint walls, or a temporary seal shall be installed to prevent infiltration of foreign material. If rain interrupts the sealing operations, the joints shall be washed, cleaned with air and be dry before proceeding with installing of the lubricant/adhesive and compression seal.

b. Installation Sequence. Longitudinal joints shall be sealed first, then seal the transverse joints. Transverse joint seals will be continuous from edge to edge of the pavement. Intersections shall be made monolithic by use of joint seal adhesive and care in fitting the intersection parts together. Seals which do not reach an intersection shall be removed and replaced with new seal as directed by the RPR at the Contractor's Expense. Seal extender pieces shall not be used at intersections.

c. Sealing joints. The sides of the joint seal or the sides of the joint shall be covered with a coating of lubricant/adhesive and the seal installed as specified. Butt joints and seal intersections shall be coated

with liberal applications of lubricant/adhesive. Lubricant/adhesive spilled on the pavement shall be removed immediately to prevent setting on the pavement.

The joint seal shall be placed at a uniform depth within the tolerances specified. The compression joint seal shall be placed to a depth of 3/16 inch (5 mm), ±1/8 inch (3 mm), below the pavement surface or below the depth of the groove unless otherwise directed by the RPR.

The seal shall be installed in the longest practicable lengths in longitudinal joints and shall be cut at the joint intersections to provide continuous installation of the seal in the transverse joints. The joint seal shall be installed in an upright position, free from twisting, distortion, and cuts. If stretch of installed joint seal exceeds 1%, adjustments shall be made to the installation equipment and procedure. Stretch of installed joint seals exceeding 2% stretch shall be removed and replaced.

After installation of the longitudinal joint seals, it shall set for a minimum of one (1) hour prior to cutting the seal at the joint intersections. For all transverse joints, the minimum length of the preformed joint seal shall be the pavement width from edge to edge.

604-4.5 Clean-up. Upon completion of the project, all unused materials shall be removed from the site, all lubricant/adhesive on the pavement surface shall be removed, and the pavement shall be left in clean condition.

604-4.6 Quality Control and Quality Assurance.

a. Quality Control The application equipment shall be inspected to assure uniform application of lubricant/adhesive to the sides of the compression joint seal or the walls of the joint. Equipment causing cutting, twisting, nicking, excessive stretching or compressing of the compression seal, or improper application of the lubricant/adhesive, shall not be used until causes of the deficiencies are determined and corrected by the Contractor.

The seal shall be inspected by the Contractor a minimum of once per 400 feet (120 m) of seal for compliance to the shrinkage or compression requirements. Measurements shall be made at the same interval to determine conformance with depth and width installation requirements.

b. Quality Assurance. Cleaned joints shall be approved by the RPR prior to installation of the lubricant/adhesive and compression joint seal.

Conformance to stretching and compression limitations shall be determined by the RPR using the following procedures:

(1) Mark the top surface of the compression seal at one-foot (30 cm) intervals in a manner clear and durable to enable length determinations of the seal.

(2) After installation, the distance between the marks on the seal shall be measured by the Contractor.

(3) If the stretching or compression exceeds the specified limit, the seal shall be removed and replaced with new joint seal at the Contractor's Expense. The seal shall be removed up to the last correct measurement.

604-4.7 Acceptance. The joint sealing system (compression seal and lubricant/adhesive) shall be inspected by the RPR for proper rate of cure and bonding to the concrete, cuts, twists, nicks, and other deficiencies. Seals exhibiting any defects prior to final acceptance of the project, shall be removed from the joint, wasted, and replaced with new material in a satisfactory manner, at the Contractor's expense, as determined by the RPR.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D2628	Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D2835	Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

Corps of Engineers

CRD C548	Standard Specification for Jet-Fuel and Heat Resistant Preformed Polychloroprene Elastomeric Joint Seals for Rigid Pavements

Unified Facilities Criteria (UFC)

UFC 3-250-08FA	Standard Practice for Sealing Joints and Cracks in Rigid and Flexible Pavements

END ITEM P-604

SECTION 014100
SPECIAL INSPECTION & TESTING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Special Inspection and Structural Testing shall be in accordance Chapter 17 of the Building Code of Michigan 2015.

B. The program of Special Inspection and Structural Testing is a quality assurance program intended to ensure that the work is performed in accordance with the Contract Documents.

C. This specification section is intended to inform the Contractor of the Owner's quality assurance program and the extent of the Contractor's responsibilities. This specification section is also intended to notify the Special Inspector, Testing Laboratory, and other Agents of the Special Inspector of their requirements and responsibilities.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Statement of Special Inspections and Tests (attached)

1.3 SCHEDULE OF INSPECTION AND TESTS

A. Required inspections and tests are described herein and in the individual specification Sections for the items to be inspected or tested.

B. An Independent Testing Laboratory (ITL) will be retained by the Owner. The Special Inspector, his agents and the ITL shall perform, but not be limited to, the following project testing and inspection services:

(a.) Soils.
(b.) Drilled piers.
(c.) Masonry.
(d.) Concrete
(e.) Reinforcing
(f.) Structural steel
(g.) Metal roof and floor deck.
(h.) Sprayed Fire-Resistant Materials

1.4 QUALIFICATIONS

A. The Special Inspector shall be a licensed Professional Engineer or Structural Engineer who is approved by the Structural Engineer of Record (SER) and Building Code Enforcement Official (BCEO). The Special Inspector may be an employee of the Testing Laboratory or an independent firm in a joint venture.

B. The Testing Laboratory and individual technicians shall be approved by the Structural Engineer of Record (SER) and Building Code Enforcement Official.

C. The Testing Laboratory shall maintain a full time licensed Professional Engineer or Structural Engineer on staff who shall certify all test reports. This Engineer shall be responsible for the training of the testing technicians and shall be in responsible charge of the field and laboratory testing operations.

D. Special Inspections shall be performed by inspectors qualified as per the Michigan Building code section 1704.2.1.

1.5 SUBMITTALS

A. The Special Inspector and Testing Laboratory shall submit, to the SER and BCEO, for review a copy of their qualifications, which shall include the names and qualifications of each of the individual inspectors and technicians who will be performing inspections or tests.

B. The Special Inspector and Testing Laboratory shall disclose any past or present business relationship or potential conflict of interest with the Contractor or any of the Subcontractors whose work will be inspected or tested.

1.6 ITL TESTING AND INSPECTION FREQUENCY

A. Specific items to be tested and the frequency as to which the tests are to be performed are as noted in Section 3.2 of this specification and on the attached “Statement of Special Inspections and Tests.”

1.7 PAYMENT

A. The Owner shall engage and pay for the services of the Special Inspector, Agents of the Special Inspector, and Testing Laboratory.

B. If any materials, which require Special Inspections, are fabricated in a plant, which is not located within 100 miles of the project, the contractor shall be responsible for the travel expenses of the Special Inspector or Testing Laboratory.

C. The Contractor shall be responsible for the cost of any retesting or reinspection of work which fails to comply with the requirements of the Contract Documents

1.8 CONTRACTOR’S RESPONSIBILITIES

A. Contractor shall cooperate with the Special Inspector, his agents, the ITL and the Owner to facilitate the execution of required services.

B. Contractor is responsible for coordinating his work with the ITL so that no work is installed without the proper tests being performed.

C. Contractor shall secure and deliver to the ITL, where required, quantities of samples of materials to be tested.

D. Contractor shall furnish casual labor and facilities for storage of test samples.

E. Contractor shall assist ITL to obtain samples at job site.

F. Contractor shall provide and pay for all project required concrete mix designs and related

confirming cylinders.

G. Contractor shall provide certified mill reports for project reinforcing and structural steel covering physical and chemical properties.

H. Contractor shall provide and pay for all testing of individual masonry units indicating compliance per specified ASTM requirements.

I. Contractor shall advise ITL, in advance, of sources of material, and instruct supplier to cooperate with ITL to achieve required inspection.

J. Contractor shall notify the ITL a minimum of 24 hours in advance of operations to allow for ITL assignment of personnel and scheduling of test. If ITL visits site and tests cannot take place, Contractor shall reimburse the Owner for total cost.

K. Contractor shall provide and pay for all project mortar and grout mix designs and confirming cylinders and/or cubes.

L. Contractor shall construct the masonry prisms required for testing of load bearing masonry under the observation of the ITL.

M. Contractor shall notify ITL 24 hours before each concrete pour and identify the proposed quantity of the pour.

N. Contractor shall employ a steel and wood fabricator which is approved by the BCEO. If the contractor employs a non-approved fabricator, the contractor shall pay for all special inspections required by the Michigan Building Code. If the contractor employs an approved fabricator, such fabricator shall provide a letter at the completion of the fabrication process stating work was performed in accordance with approved construction documents.

O. The Contractor shall keep at the project site the latest set of construction drawings, field sketches, approved shop drawings, and specifications for use by the inspectors and testing technicians.

P. The Special Inspection program shall in no way relieve the Contractor of his obligation to perform work in accordance with the requirements of the Contract Documents or from implementing an effective Quality Control program. All work that is subjected to Special Inspections shall first be reviewed by the Contractor’s quality control personnel.

Q. The Contractor shall be solely responsible for construction site safety.

R. Contractor's responsibility related to project testing as required by technical sections hereinafter:

1. The Contractor shall make arrangements and schedule the proper authorities for inspection of the system.

2. The Contractor shall obtain from governing authorities the proper test procedures that are required for the system tests.

3. All tests shall be made in the presence and to the satisfaction of authorities having jurisdiction and the Contractor shall provide five (5) copies of tests witnessed to the Engineer.

4. See technical sections hereinafter for further details of testing requirements.

S. Contractor shall correct any discrepancies noted in Testing Laboratory report. Contractor shall coordinate with Testing Laboratory to review corrections and update reports. Final reports shall show all discrepancies were corrected.

1.9 TESTING LABORATORY (ITL) RESPONSIBILITIES

1. Testing Laboratory shall cooperate with Contractor and provide qualified personnel.

2. Testing Laboratory shall inspect and/or test assemblies, specimens, work performed, and techniques as specified.

3. Testing Laboratory shall promptly notify Contractor and SER of observed irregularities, deficiencies in work, and report any test results that fail to comply with the requirements of the Contract Documents.

4. Testing Laboratory shall promptly process and distribute all copies of test reports and related instructions to ensure all necessary retesting and/or replacement of materials with the least possible delay to the progress of the work. The testing laboratory shall provide a written report within three days related to every project test and inspection except daily reports are required for concrete testing. Distribution of reports to each of the following:

a.	Owner	1 copy
b.	Contractor	2 copies
c.	Engineer / Architect	2 copies
d.	Building Code Official	(as requested)

5. Each report shall include:

   a. Date issued.
   b. Project title and number.
   c. Testing Laboratory name, address, and telephone number.
   d. Name of Special Inspector and/or Testing Laboratory inspector and job number.
   e. Date and time of sampling or inspection.
   f. Record of temperature and weather conditions.
   g. Date of test.
   h. Identification of specification section.
   i. Location of sample or test in the project.
   j. Type of inspection or tests.
   k. Interpretation of test results.
   1. Each report shall have testing laboratory written comments stating that the test results comply with the specified requirements and/or identify retest instructions given to the Contractor and require follow-up test reports that are identified as the retest reports. The retest reports shall identify the original test report.

6. The Testing Laboratory is not authorized to release, revoke, alert or enlarge on requirements of Contract Documents.

7. The Testing Laboratory is not authorized to perform any duties of the Contractor.

5. The Testing Laboratory shall make tests necessary to assure compliance with the plans and specifications and label all test samples and cylinders with identifying marks.

6. The Special Inspector and/or Testing Laboratory shall not have control over the Contractor's means and methods of construction.

7. The Special Inspector and/or Testing Laboratory shall not be responsible for construction site safety.

8. The Special Inspector and/or Testing Laboratory have no authority to stop the work.

1.10 TESTING LABORATORY INSURANCE REQUIREMENTS

A. Provide comprehensive and general liability insurance with limits of liability of not less than five hundred thousand dollars ($500,000) for property damage per occurrence.

B. Provide statutory worker's compensation insurance and employer's liability insurance with applicable maximum coverage as required by governing law.

C. Provide excess liability insurance, umbrella form, in the amount of five hundred thousand dollars ($500,000).

D. Provide errors and omissions professional liability insurance in the amount of one million dollars ($1,000,000).

PART 2 PRODUCTS (Not used)

PART 3 EXECUTION

3.1 TESTING REQUIREMENTS
A. Refer to Statement of Special Inspection

3.3 FINAL REPORT OF SPECIAL INSPECTIONS

A. The Final Report of Special Inspections shall be completed by the Special Inspector and /or the Testing Laboratory and be submitted to the SER and BCEO prior to issuance of a Certificate of Use and Occupancy.

END OF SECTION

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C&S COMPANIES	**C&S ENGINEERS, INC.** **499 COL. EILEEN COLLINS BLVD.** **Syracuse, NY 13212**	**STATEMENT OF SPECIAL INSPECTIONS & TESTS** As Required by the 2015 Building Code of Michigan Supplement and 2015 International Building Code.

BC § 1704.3 requires that the project Registered Design Professional in responsible charge to complete the Statement of Special Inspections. Completion of this Statement of Special Inspections and submission to the Code Compliance Unit with the Construction Permit Application is a condition for issuance of the Construction Permit.

Project: GRR SRE Building Expansion	**Project #: C-378**
Project Title: SRE Expansion	**Project Manager: Amy Sonbuchner, AIA**
Architect/Engineer: C&S Engineers	
Name of Person Completing this Statement: John W. Obleman, P.E.	**Date: September 18, 2023**
Comments:	

INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
A. Special Cases (Add requirements under Part S as necessary)			1705.1.1			Special Inspections and Tests shall be required for proposed work that is, in the opinion of the building official, unusual in its nature.
B. Steel Construction.			1705.2			
1. Structural Steel			1705.2.1			
a. Inspection tasks prior to welding;			1705.2.1			AISC 360 Table N5.4-1
i. Welding procedure specifications (WPSs) available	X		1705.2.1	☒		AISC 360 Table N5.4-1
ii. Manufacturer certifications for welding consumables available	X		1705.2.1	☒		AISC 360 Table N5.4-1
iii. Material identification (type/grade)		X	1705.2.1	☒		AISC 360 Table N5.4-1
iv. Welder identification system		X	1705.2.1	☒		AISC 360 Table N5.4-1 The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
v. Fit up of groove welds		X	1705.2.1	☒		AISC 360 Table N5.4-1

(including joint geometry)						
vi. Configuration and finish of access holes		X	1705.2.1	☒		AISC 360 Table N5.4-1
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
vii. Fit-up of fillet welds		X	1705.2.1	☒		AISC 360 Table N5.4-1
viii. Check Welding equipment		X	1705.2.1	☒		AISC 360 Table N5.4-1
b. Inspection Tasks During Welding			1705.2.1			AISC 360 Table N5.4-2
i. Use of qualified welders.		X	1705.2.1	☒		AISC 360 Table N5.4-2
ii. Control and Handling of welding consumables.		X	1705.2.1	☒		AISC 360 Table N5.4-2
iii. No welding over cracked tack welds.		X	1705.2.1	☒		AISC 360 Table N5.4-2
iv. Environmental Conditions		X	1705.2.1	☒		AISC 360 Table N5.4-2
v. Verify WPS followed		X	1705.2.1	☒		AISC 360 Table N5.4-2
vi. Verify Welding Techniques		X	1705.2.1	☒		AISC 360 Table N5.4-2
c. Inspection Tasks after Welding			1705.2.1			AISC 360 Table N5.4-3
i. Welds cleaned		X	1705.2.1	☒		AISC 360 Table N5.4-3
ii. Size, length, and location of welds	X		1705.2.1	☒		AISC 360 Table N5.4-3
iii. Welds meet visual acceptance criteria	X		1705.2.1	☒		AISC 360 Table N5.4-3
iv. Arc strikes	X		1705.2.1	☒		AISC 360 Table N5.4-3
v. K-area			1705.2.1	☒		AISC 360 Table N5.4-3; When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks within 3 in. (75mm) of the weld.
vi. Backing removed and weld tabs removed (if required)	X		1705.2.1	☒		AISC 360 Table N5.4-3
vii. Repair activities	X		1705.2.1	☒		AISC 360 Table N5.4-3
viii. Document acceptance or rejection of welded joint or member	X		1705.2.1	☒		AISC 360 Table N5.4-3
d. Inspection Tasks Prior to Bolting			1705.2.1			AISC 360 Table N5.6-1
i. Manufacturer's certification available for fastener materials	X		1705.2.1	☒		AISC 360 Table N5.6-1
ii. Fasteners marked in accordance with ASTM requirements		X	1705.2.1	☒		AISC 360 Table N5.6-1

iii. Proper fasteners selected for the joint detail (grade, type, bolt length if threads are to be excluded from shear plane)		X	1705.2.1	☒		AISC 360 Table N5.6-1
iv. Proper bolting procedure selected for joint detail		X	1705.2.1	☒		AISC 360 Table N5.6-1
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
v. Connecting elements, including the appropriate faying surface condition and hole preparation, if specified, meet applicable requirements.		X	1705.2.1	☒		AISC 360 Table N5.6-1
vi. Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used.		X	1705.2.1	☒		AISC 360 Table N5.6-1
vii. Proper storage provided for bolts, nuts, washers and other fastener components.		X	1705.2.1	☒		AISC 360 Table N5.6-1
e. Inspection Tasks During Bolting			1705.2.1			AISC 360 Table N5.6-2
i. Fastener assemblies, of suitable condition, placed in all holes and washers (if required) are positioned as required.		X	1705.2.1	☒		AISC 360 Table N5.6-2
ii. Joint brought to the snug-tight condition prior to the pretensioning operation.		X	1705.2.1	☒		AISC 360 Table N5.6-2
iii. Fastener component not turned by the wrench prevented from rotating.		X	1705.2.1	☒		AISC 360 Table N5.6-2
iv. Fasteners are pretensioned in accordance with the RCSC Specification, progressing systematically from the most rigid point toward the free edges.		X	1705.2.1	☒		AISC 360 Table N5.6-2
f. Inspection Tasks After Bolting			1705.2.1			AISC 360 Table N5.6-3
i. Document acceptance or rejection of bolted connections.	X		1705.2.1	☒		AISC 360 Table N5.6-3
g. Inspection of Steel Elements of Composite Construction Prior to Concrete Placement			1705.2.1			AISC 360 Table N6.1
i. Placement and installation of steel deck.	X		1705.2.1	☒		AISC 360 Table N6.1

ii. Placement and installation of steel headed stud anchors.	X		1705.2.1	☒		AISC 360 Table N6.1
iii. Document acceptance or rejection of steel elements	X		1705.2.1	☒		AISC 360 Table N6.1
2. Cold-Formed Steel Deck			1705.2.2	☒		
a. Inspection or Execution Tasks prior to Deck Placement			1705.2.2			SDI QA/QC Table 1.1
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
i. Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness.	X		1705.2.2	☒		SDI QA/QC Table 1.1
ii. Document acceptance or rejection of deck and deck accessories.	X		1705.2.2	☒		SDI QA/QC Table 1.1
b. Inspection or Execution Tasks after Deck Placement						SDI QA/QC Table 1.2
i. Verify compliance of deck and all deck accessories installation with construction documents.	X		1705.2.2	☒		SDI QA/QC Table 1.2
ii. Verify deck materials are represented by the mill certifications that comply with the construction documents.	X		1705.2.2	☒		SDI QA/QC Table 1.2
iii. Document acceptance or rejection of installation of deck and deck accessories.	X		1705.2.2	☒		SDI QA/QC Table 1.2
c. Inspection or Execution Tasks Prior to Welding			1705.2.2			SDI QA/QC Table 1.3
i. Welding Procedure Specifications (WPS) available.		X	1705.2.2	☒		SDI QA/QC Table 1.3
ii. Manufacturer certifications for welding consumables available		X	1705.2.2	☒		SDI QA/QC Table 1.3
iii. Material identification (type/grade).		X	1705.2.2	☒		SDI QA/QC Table 1.3
iv. Check welding equipment.		X	1705.2.2	☒		SDI QA/QC Table 1.3
d. Inspection or Execution Tasks during Welding			1705.2.2			SDI QA/QC Table 1.4
i. Use of qualified welders.		X	1705.2.2	☒		SDI QA/QC Table 1.4
ii. Control and handling of welding consumables.		X	1705.2.2	☒		SDI QA/QC Table 1.4
iii. Environmental conditions		X	1705.2.2	☒		SDI QA/QC Table 1.4

(wind speed, moisture, temperature).						
iv. Verify WPS followed.		X	1705.2.2	☒		SDI QA/QC Table 1.4
e. Inspection or Execution Tasks after Welding			1705.2.2			SDI QA/QC Table 1.5
i. Verify size and location of welds, including support, sidelap, and perimeter welds.	X		1705.2.2	☒		SDI QA/QC Table 1.5
ii. Welds meet visual acceptance criteria.	X		1705.2.2	☒		SDI QA/QC Table 1.5
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
iii. Verify repair activities.	X		1705.2.2	☒		SDI QA/QC Table 1.5
iv. Document acceptance or rejection of welds.	X		1705.2.2	☒		SDI QA/QC Table 1.5
f. Inspection or Execution Tasks prior to Mechanical Fastening			1705.2.2			SDI QA/QC Table 1.6
i. Manufacturer installation instructions available for mechanical fasteners.		X	1705.2.2	☒		SDI QA/QC Table 1.6
ii. Proper tools available for fastener installation.		X	1705.2.2	☒		SDI QA/QC Table 1.6
iii. Proper storage for mechanical fasteners.		X	1705.2.2	☒		SDI QA/QC Table 1.6
g. Inspection or Execution Tasks during Mechanical Fastening			1705.2.2			SDI QA/QC Table 1.7
i. Fasteners are positioned as required.		X	1705.2.2	☒		SDI QA/QC Table 1.7
ii. Fasteners are installed in accordance with manufacturer's instructions.		X	1705.2.2	☒		SDI QA/QC Table 1.7
h. Inspection or Execution Tasks after Mechanical Fastening			1705.2.2			SDI QA/QC Table 1.8
i. Check spacing, type, and installation of support fasteners.	X		1705.2.2	☒		SDI QA/QC Table 1.8
ii. Check spacing, type, and installation of sidelap fasteners.	X		1705.2.2	☒		SDI QA/QC Table 1.8
iii. Check spacing, type, and installation of perimeter fasteners.	X		1705.2.2	☒		SDI QA/QC Table 1.8
iv. Verify repair activities.	X		1705.2.2	☒		SDI QA/QC Table 1.8
v. Document acceptance or rejection of mechanical fasteners.	X		1705.2.2	☒		SDI QA/QC Table 1.8

3. Open-Web Steel Joists and Joist Girders			1705.2.3			
a. Installation of open-web steel joists and joist girders			Table 1705.2.3	☐		
i. End connections – welded or bolted.		X	Table 1705.2.3	☐		SJI Specifications listed in Section 2207.1.
ii. Bridging – Horizontal or diagonal.			Table 1705.2.3			
a. Standard bridging.		X	Table 1705.2.3	☐		SJI Specifications listed in Section 2207.1.
b. Bridging that differs from the SJI specifications listed in Section 2207.1		X	Table 1705.2.3	☐		
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
4. Cold-Formed Steel Trusses spanning 60 feet or Greater		X	1705.2.4	☐		The Special Inspector shall verify that the temporary restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.
C. Concrete Construction			1705.3			
1. Inspect reinforcement, including prestressing tendons, and verify placement.		X	Table 1705.3	☒		ACI 318 Ch. 20, 25.2, 25.3, 26.6.1-26.6.3 IBC 1908.4
2 Reinforcing Bar Welding:			Table 1705.3 1705.3.1			AWS D1.4, ACI 318: 26.6.4
a. Verify weldability of reinforcing bars other than ASTM A706:		X	Table 1705.3	☐		AWS D1.4 ACI 318: 26.6.4
b. Inspect single pass fillet welds, maximum 5/16"; and		X	Table 1705.3	☐		AWS D1.4 ACI 318: 26.6.4
c. Inspect all other welds	X		Table 1705.3	☐		AWS D1.4 ACI 318: 26.6.4
3. Inspect anchors cast in concrete.		X	Table 1705.3	☒		ACI 318: 17.8.2
4. Inspect anchors post-installed in hardened concrete members.		X	Table 1705.3	☒		
a. Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads.	X		Table 1705.3	☒		ACI 318: 17.8.2.4
b. Mechanical anchors and adhesive anchors not defined in		X	Table 1705.3	☒		ACI 318: 17.8.2

item 4a.						
5. Verify use of required design mix		X	Table 1705.3	☒		ACI 318: Ch. 19, 26.4.3, 26.4.4 IBC 1904.1, 1904.2, 1908.2, 1908.3
6. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of concrete.	X		Table 1705.3	☒		ASTM C172, ASTM C31; ACI 318: 26.4, 26.12; IBC 1908.10
7. Inspect concrete and shotcrete placement for proper application techniques.	X		Table 1705.3	☒		ACI 318: 26.5; IBC 1908.6, 1908.7, 1908.8
8. Verify maintenance of specified curing temperature and techniques.		X	Table 1705.3	☒		ACI 318: 26.5.3-26.5.5 IBC: 1908.9
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
9. Inspect Prestressed concrete for:			Table 1705.3	☐		
a. Application of prestressing forces; and	X		Table 1705.3	☐		ACI 318: 26.10
b. Grouting of bonded prestressing tendons	X		Table 1705.3	☐		ACI 318: 26.10
10. Inspect erection of precast concrete members		X	Table 1705.3	☐		ACI 318: Ch. 26.8
11. Verify in-situ concrete strength, prior to stressing tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.		X	Table 1705.3	☐		ACI 318: 26.11.2
12. Inspect formwork for shape, location and dimensions of the concrete member being formed.		X	Table 1705.3	☐		
D. Masonry Construction (Check LA, LB or LC below) ☐ LA = Level A Quality Assurance ☒ LB = Level B Quality Assurance ☐ LC = Level C Quality Assurance			1705.4			TMS 402/ACI530/ASCE5 TMS 602/ACI530.1/ASCE6
Level A Quality Assurance: Minimum Verification			1705.4			

A1. Prior to construction, verify certificates of compliance used in masonry construction.		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.1
Level B Quality Assurance: Minimum Special Inspections			1705.4			
B1. Verify Compliance with approved submittals.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B2: As masonry construction begins, verify that the following are in compliance:			1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B2a: Proportions of site-prepared mortar.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B2b: Construction of Mortar Joints.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B2c: Grade and size of prestressing tendons and anchorage.		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.2
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
B2d: Location of reinforcement, connectors, and prestressing tendons and anchorage.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B2e: Prestressing technique.		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.2
B2f: Properties of thin bed mortar for AAC masonry.	X	X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.2 Continuous inspection required for the first 5000sf of AAC Masonry, Periodic inspection is required after the first 5000sf of AAC masonry.
B3. Prior to grouting, verify that the following are in compliance:		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B3a: Grout space.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B3b: Grade, type, and size of reinforcement and anchor bolts, and prestressing tendons and anchorage.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B3c: Placement of reinforcement, connectors, and prestressing tendons and anchorage.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B3d: Proportions of site-prepared grout for bonded tendons.		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.2

B3e: Construction of mortar joints.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B4: Verify during construction:		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B4a: Size and location of structural elements.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B4b: Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B4c: Welding of reinforcement.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.2
B4d: Preparation, construction, and protection of masonry during cold weather (temperature below 40dF) or hot weather (temperature above 90dF)		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B4e: Application and measurement of prestressing force.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.2
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
B4f: Placement of grout and prestressing grout for bonded tendons is in compliance.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.2
B4g: Placement of AAC masonry units and construction of thin-bed mortar joints.	X	X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.2 Continuous inspection required for the first 5000sf of AAC Masonry, Periodic inspection is required after the first 5000sf of AAC masonry.
B5: Observe preparation of grout specimens, mortar specimens, and/or prisms.		X	1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
Minimum Tests			1705.4			
B6: Verification of Slump flow and Visual Stability Index (VSI) as delivered to the project site in accordance with Specification Article 1.5B1.b.3 for self-consolidating grout.			1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2
B7: Verification of f'm and f'aac in accordance with Specification Article 1.4B prior to construction, except where specifically exempted by this			1705.4	☒		TMS 402/ACI530/ASCE5 Table 3.1.2

Code.						
Level C Quality Assurance: Minimum Special Inspections			1705.4			
C1. Verify compliance with the approved submittals.		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2. Verify that the following are in compliance:			1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2a. Proportions of site mixed mortar, grout and prestressing grout for bonded tendons.		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2b. Grade, type, and size of reinforcement and anchor bolts, and prestressing tendons and anchorages.		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2c. Placement of masonry units and construction of mortar joints.		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2d. Placement of reinforcement, connectors, and prestressing tendons and anchorages.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2e. Grout spacing prior to grouting.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2f. Placement of grout and prestressing grout for bonded tendons.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
C2g. Size and location of structural elements.		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2h. Type, size, and location of anchors including other details of anchorage of masonry to structural members, frames, or other construction.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2i. Welding of reinforcement.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2j. Preparation, construction, and protection of masonry during cold weather (temperature below 40dF) or hot weather (temperature above 90dF).		X	1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2k. Application and measurement of prestressing force.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C2l. Placement of AAC masonry units and construction of thin-bed mortar joints.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3

C2m. Properties of thin-bed mortar for AAC masonry.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
C3. Observe preparation of grout specimens, mortar specimens, and/or prisms.	X		1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
Minimum Tests			1705.4			
D1. Verification of f'm and f'AAC in accordance with Specification Article 1.4B prior to construction and for every 5,000sf during construction.			1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
D2. Verification of proportions of materials in premixed or preblended mortar, prestressing grout, and grout other than self-consolidating grout, as delivered to the project site.			1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
D3. Verification of Slump flow and Visual Stability Index (VSI) as delivered to the project site in accordance with Specification Article 1.5B.1.b.3 for self-consolidating grout.			1705.4	☐		TMS 402/ACI530/ASCE5 Table 3.1.3
E. Wood Construction			1705.5			
1. High Load Diaphragms		X	1705.5.1	☐		
2. Metal Plate Connected Wood Trusses spanning 60 feet or Greater		X	1705.5.2	☐		
F. Soils			1705.6			
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.		X	Table 1705.6	☒		
2. Verify excavations are extended to a proper depth and have reached proper material.		X	Table 1705.6	☒		
3. Perform classification and testing of compacted fill materials.		X	Table 1705.6	☒		
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	X		Table 1705.6	☒		
5. Prior to placement of compacted fill, inspect subgrade		X	Table 1705.6	☒		

and verify that site has been prepared properly.						
G. Driven Deep Foundations			1705.7			
1. Verify element materials, sizes and lengths, comply with the requirements.	X		Table 1705.7	☐		
2. Determine capacities of test elements and conduct additional load tests, as required.	X		Table 1705.7	☐		
3. Inspect driving operations and maintain complete and accurate records for each elements.	X		Table 1705.7	☐		
4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element.	X		Table 1705.7	☐		
5. For steel elements, perform additional special inspections in accordance with Section 1705.2.	-	-	Table 1705.7	☐		
6. For concrete elements and concrete-filled elements, perform tests and additional special inspections in accordance with Section 1705.3.	-	-	Table 1705.7	☐		
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
7. For specialty elements, perform additional inspections as determined by the registered design professional in responsible charge.	-	-	Table 1705.7	☐		
H. Cast-in-place Deep Foundations			1705.8			
1. Inspect drilling operations and maintain complete and accurate records for each element.	X		Table 1705.8	☐		
2. Verify placement locations and plumbness, confirm	X		Table 1705.8	☐		

element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes.						
3. For concrete elements, perform tests and additional special inspections in accordance with Section 1705.3.	-	-	Table 1705.8	☐		
I. Helical Pile Foundations	X		1705.9			
J. Fabricated Items			1705.10 1704.2.5			Where fabrication of structural, load-bearing, or lateral load resisting members or assemblies is being conducted on the premises of a fabricators shop
1. Structural Steel		X		☐		
2. Steel Joists		X		☐		
3. Precast Concrete		X		☐		
4. Wood Construction		X		☐		
K. Special Inspections for Wind Resistance			1705.11			RDP to identify the main windforce-resisting systems and wind-resisting components that are subject to special inspection per BC Section 1704.3.3.
1. Structural Wood	X	X	1705.11.1	☐		
2. Cold Formed steel light framed Construction		X	1705.11.2	☐		
3. Wind-resisting Components		X	1705.11.3	☐		
L. Special Inspections for Seismic Resistance			1705.12			RDP to identify the designated seismic systems and seismic force-resisting systems that are subject to special inspection per BC Section 1704.3.2.
INSPECTIONS AND TESTS (Continuous & Periodic is as defined by the BC)	**CONTINUOUS**	**PERIODIC**	**BC REFERENCE**	**CHECK IF REQUIRED**	**SPECIFICATION REFERENCE AND CLARIFYING NOTES (by RDP)[1]**	**COMMENTARY/NOTES and REFERENCE STANDARDS**
1. Structural Steel		X	1705.12.1	☐		AISC 341 Section J
2. Structural Wood	X	X	1705.12.2	☐		
3. Cold Formed steel light framed Construction		X	1705.12.3	☐		
4. Designated seismic systems	X	X	1705.12.4	☐		ASCE 7 Section 13.2.2
5. Architectural Components		X	1705.12.5	☐		
6. Plumbing, Mechanical, and		X	1705.12.6	☐		

Electrical Components						
7. Storage Racks		X	1705.12.7	☐		
8. Seismic Isolation Systems		X	1705.12.8	☐		
9. Cold Formedsteel special bolted moment frames		X	1705.12.9	☐		
M. Testing for Seismic Resistance			1705.13			
1. Structural Steel		X	1705.13.1	☐		
2. Nonstructural Components		X	1705.13.2	☐		
3. Designated Seismic Systems		X	1705.13.3	☐		
4. Seismic Isolation Systems		X	1705.13.4	☐		
N. Sprayed Fire-Resistant Materials			1705.14			
1. Physical and visual tests		X	1705.14.1	☐		
2. Structural Member Surface Conditions		X	1705.14.2	☐		
3. Application		X	1705.14.3	☐		
4. Thickness		X	1705.14.4	☐		
5. Density		X	1705.14.5	☐		
6. Bond Strength		X	1705.14.6	☐		
O. Mastic and Intumescent Fire Resistant Coatings		X	1705.15	☐		
P. Exterior Insulation and Finis Systems (EIFS)			1705.16			
1. Exterior Insulation and Finish Systems (EIFS)		X	1705.16	☐		
2. Water Resistive Barrier Coating		X	1705.16.1	☐		
Q. Fire-Resistant Penetrations and Joints			1705.17			
1. Penetration Firestops		X	1705.17.1	☐		
2. Fire-resistant joint systems		X	1705.17.2	☐		
R. Testing for Smoke Control			1705.18			
1. Testing Scope		X	1705.18.1	☐		
2. Qualifications		X	1705.18.2	☐		
S. Additional Special Inspections/Tests			The registered design professional of record shall identify if additional tests and inspection defined by BC Section 1705.1.1 are required and provide specific requirements below.			
1.	☐	☐		☐		
2.	☐	☐		☐		
3.	☐	☐		☐		
4.	☐	☐		☐		
5.	☐	☐		☐		
6.	☐	☐		☐		

7.	☐	☐		☐		
8.	☐	☐		☐		
9.	☐	☐		☐		
10.	☐	☐		☐		

NOTES:

1. RDP to provide reference specification section detailing the requirements for inspections and/or tests and other clarifying notes, as necessary.
2. Commentary/Notes are provided for information only and are not intended to provide complete details of the required tests and inspections. Refer to the Building Code of Michigan for complete and detailed requirements.

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SECTION 024119
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary of Work" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, , for dust control, and, , for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations.Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

a. Equipment currently parked in footprint of site..

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials:

1. It is not expected that hazardous materials will be encountered in the Work.

a. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. PEMB Roof.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least two hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly.[**Comply with requirements in Section 017419 "Construction Waste Management and Disposal."**]

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least **3/4 inch** at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain,

using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 074113.13 Formed Metal Roof Panels for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.9 SELECTIVE DEMOLITION SCHEDULE

A. Remove: Fuel Farm as indicated in drawings and specifications.

END OF SECTION 024119

SECTION 02 65 00
UNDERGROUND STORAGE TANK REMOVALS

PART 1- GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 50 00 “Temporary Facilities and Controls.”

B. Section 02 41 19 “Selective Demolition.”

C. Section 26 00 10 “Electrical General Requirements.”

D. Section MDOT 205 “Roadway Earthwork.”

1.02 SUBMITTALS

A. Waiver of Submittals: The “Waiver of Certain Submittal Requirements” in Section 013300 does not apply to this Section.

B. Removal procedures and schedule.

C. Plan of Operations:
1. Include, at a minimum, a description of project approach covering methods for product transfer, sampling, analysis, removal and disposal of all waste. Additionally, the Plan of Operations shall include:
   a. Description of product transfer method from existing underground storage tanks (USTs) to new aboveground storage tanks (ASTs).
   b. Description of soil removal methods to be employed; including excavation protection.
   c. Description of a method for the decontamination of the excavator bucket prior to the procurement of soil samples at the completion of principal excavation work in each tank area.
   d. Description of the waste segregation and staging methods to be used for soils, poly sheeting, and spent personal protective equipment.
   e. Methods to be used for dewatering.
   f. Methods to be used for cleaning of tank and piping.
   g. Methods to be used for placement and compaction of backfill materials.
   h. Identification of all waste transporters and disposal facilities including copies of all required certifications and permits.
   i. Description methods to be employed to prevent storm water pollution from staged petroleum-contaminated soil, if encountered.
   j. Required certifications and permits including copies of valid permits for all waste haulers, disposal sites, and weigh scales
2. Submit at a minimum of two (2) weeks prior to commencing work.
3. Waste shall include, but not be limited to tanks, piping, fuel dispensers and under-dispenser containment sumps, concrete deadmen and / or ballast pads, concrete pads, tank contents, wash water, soils, samples, and used personal protective equipment (PPE).

D. Copy of notifications to the Michigan Department of Licensing and Regulatory Affairs (LARA), and the Michigan Department of Environmental Quality (DEQ) Remediation

Division, informing the Departments of the planned closure and removal of the tank.

E. Record Documents:
1. Meter readings of the volume in gallons of all product transferred from the existing USTs to the new ASTs.
2. Completed waste manifests (or bill of lading for non-hazardous materials) as described herein, accounting for all materials removed from the site.
3. Copies of all load tickets, if applicable.
4. Certification of destination, receipt, and disposal of demolition materials.
5. Landfill or scrap yard records indicating receipt and acceptance of UST, appurtenances, and any contaminated soil by a landfill facility licensed to accept such materials.

F. Health and Safety Plan, (HASP): Including regulations for confined space entry (29 CFR 1910.146) and other applicable portions of 29 CFR 1926, that addresses exposure of workers to product and accumulated sludge that may need to be transferred and/or removed from the tanks.
1. The Owner's Representative will review and comment on the HASP but will neither approve nor disapprove it.

G. Confined Space Entry Permit and the worker training certificates required to clean out the tank once it is excavated.

H. Quality Control Submittals:
1. Excavation Procedure: Submit a layout drawing or detailed outline of intended excavation procedure for the Owner's information.
2. This submittal will not relieve the Contractor of responsibility for the successful performance of intended excavation methods.

I. UST Closure Report: Furnished by Environmental Consultant, which will be coordinated by the Owner's Representative.

1.03 REQUIRED CERTIFICATIONS AND LICENSES

A. Employees involved in hazardous waste operations shall have been trained in accordance with OSHA Final Standards to Protect Workers in Hazardous Waste Operations 29 CFR 1910.120 or most recent revision thereof.

B. Waste haulers shall maintain a valid waste transporter permit.

1.04 REGULATORY REQUIREMENTS

A. Abide by all applicable rules and regulations, including but not limited to the following:
1. Michigan Fire Prevention Code, 1941 PA 207.
2. Michigan Department of Licensing and Regulatory Affairs (LARA), Bureau of Fire Services, Storage Tank Division, Underground Storage Tanks Regulations Part 211, Underground Storage Tank Regulations, of Act 451 of 1994, as amended, and the Michigan Underground Storage Tank Rules (MUSTR).
3. Michigan Department of Environmental Quality (DEQ) Remediation Division.
4. American Petroleum Institute, Recommended Practice 1604, Second Edition, December, 1987, "Removal and Disposal of Used Underground Petroleum Storage Tanks", and revisions thereof.
5. Federal Underground Storage Tank (UST) Regulations, 40 CFR Part 280.
6. Applicable OSHA worker safety regulations.

7. State, county, and federal regulations pertaining to the handling, storage, transport, and disposal of wastes generated during the project.
8. Coordinate and obtain all permits as required by permitting authorities.

1.05 ABBREVIATIONS

A. The following terms shall have the meanings ascribed to them in this Section, wherever they appear in this Section.
1. API: American Petroleum Institute.
2. AST: Aboveground Storage Tank
3. DEQ: Michigan Department of Environmental Quality.
4. FRP: Fiberglass-Reinforced Plastic.
5. LARA: Michigan Department of Licensing and Regulatory Affairs.
6. MUSTR: Michigan Underground Storage Tank Rules.
7. NFPA: National Fire Protection Association.
8. OSFM: Office of the State Fire Marshal.
9. OSHA: Occupational Safety and Health Administration.
10. PPE: Personal Protective Equipment
11. USEPA: United States Environmental Protection Agency.
12. UST: Underground Storage Tank.
13. HASP: Health and Safety Plan.

1.06 NOTIFICATION

A. Notify (by telephone and email) the Owner's Representative at least 48 hrs prior to beginning closure operations at the tank.

B. If contaminated soils are encountered, the Owner's Representative will notify applicable regulatory authorities.

1.07 EXISTING CONDITIONS

A. Protect and safeguard from damage all existing structural systems, fencing, equipment, and surfaces that will remain. Contractor shall repair any damage to structures, appurtenances or the landscape not scheduled for removal work.

B. Existing USTs: Two 12,000-gallon, single-wall USTs, one unleaded gasoline, one diesel fuel, installed circa 1999. Each tank is 10'-6" in diameter by 18'-6" long and weigh approx. 9,500 lbs. empty.
a. DEQ Facility Number: 00040196.
b. For each tank, the Contractor shall assume that there will be product remaining above the low draw-off point (assumed to be 4 to 6-inches). The Contractor shall transfer this product to the new AST system containing the same product.

C. An Environmental Sampling Investigation was conducted by DLZ Michigan in February 2023 around the two subject USTs. According to the Investigation report, DLZ identified no evidence of release during advancement of the borings and sample collection. In addition, no contaminants of concern were detected above Part 213 Generic Cleanup Criteria and Risk-Based Screening Levels. The Investigation Report can be made available to the Contractor upon written request.

1.08 ENVIRONMENTAL OVERSIGHT

A. The Owner's Representative will secure the services of an authorized Environmental

Consultant to act on his behalf for field observation.

B. The Environmental Consultant will advise the Owner's Representative on environmental matters.
   1. Such advisement does not relieve the Contractor's obligation to comply with all applicable environmental and health and safety regulations promulgated by the federal, state, or local governments.
   2. No activity on the part of the Environmental Professional represents the Contractor's compliance with applicable environmental or health and safety regulations.

PART 2- PRODUCTS

2.01 DRUMS

A. Provide USDOT approved drums, as necessary.

PART 3 - EXECUTION

3.01 PREPARATION

A. Contact the Michigan Department of Licensing and Regulatory Affairs (LARA), Bureau of Fire Services, Storage Tank Division and the Michigan Department of Environmental Quality (DEQ) Remediation Division at least 30 business days prior to the removal of the underground petroleum storage tanks.

B. Locate and clearly mark all subsurface utilities in the area of excavation. Conduct activities to minimize interference with, and to protect the existing surfaces of, adjacent structures or utilities.

C. Provide, erect, and maintain temporary barriers and security devices.

D. Conduct operations with minimum interference to public or private thoroughfares. Do not close or obstruct drive areas or sidewalks without permits.

E. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

F. Remove and dispose of abandoned conduit or piping within excavated areas and plug ends.
   1. Identify disconnection locations on Project Record Documents.

G. Perform tank removals in a manner that will minimize dust, noise, and other nuisance. Maintain haul routes for disposal of material clean and free of debris.

H. Provide monitoring equipment at site as required by the Site Health and Safety Plan. Operate and maintain in accordance with manufacturer's recommendations.

I. Perform the Work with consideration for facility personnel and the public. Maintain barriers between work areas and adjacent facilities at all times, with necessary signs, lights, bracing and guards for the protection of all facility personnel, the public, and existing facilities.

J. Schedule the Work in advance with the Owner's Representative to coordinate work schedules.

K. Notify the Owner's Representative minimum of 30 days in advance of tank removals.
   1. Alternative arrangements must be approved in writing by the Owner's Representative.
   2. The Contractor shall arrange and pay for a certified environmental testing laboratory to analyze samples of soils, liquids, sludges and ground water destined for disposal.

3.02 UNDERGROUND STORAGE TANK LIQUID REMOVAL

A. Prior to excavation around the UST, empty the tanks as follows:
   1. Transfer all product remaining above the low draw-off point to the new AST containing the same product.
      a. The Contractor shall submit a price per gallon in their bid for this effort.
      b. Provide meter readings of the volume in gallons of all product transferred from the existing USTs to the new ASTs.
   2. Drain and flush piping into the tank.
   3. Pump out the liquid below the draw-off point (tank bottom).
      a. Use an explosion-proof hand or vacuum pump.
      b. Approximately 4 - 6" of liquid is estimated to remain in the tank below the lowest draw-off point; this is equivalent to 300-gallons for a typical 12,000-gallon tank.
      c. Pump out the entire tank bottom including the remaining product layer.
      d. Provide proof of proper disposal to Environmental Consultant and Owner's Representative.
   4. Bond equipment to tank and ground tank to a separate ground when purging tank with compressed air or inert gas under pressure.

3.03 UNDERGROUND TANK AND PIPING REMOVAL

A. Inert the interior atmosphere before extracting the tank from its location.

B. Excavate to the top of the tank and stockpile soil as specified in Section MDOT 205, Roadway Earthwork. In the event contaminated soil and/or groundwater is discovered remove and temporarily stockpile the material as specified herein this Section.

C. Excavation around existing UST:
   1. Dig down to expose upper half of tank. During excavation, exercise extreme caution in order to maintain the integrity of the UST.
   2. Perform excavation in the presence of the Owner's Representative who will check material for possible contamination using an organic vapor meter (OVM) or equivalent. Place excavated material in a separate stockpile as directed, pending disposal.

D. Disconnect suction, inlet, gauge and all other tank fixtures, except the vent line.

E. Temporarily plug all tank openings, complete the excavation, and remove the tank, placing it in a secure location. Tank must be blocked to prevent movement.

F. Spills or drips shall be contained to prevent contamination of soils during removal.

G. Excavate to uncover existing piping associated with the tank.

1. Remove all underground piping.
2. Do not rupture tank or pipelines.
3. Pipe trenches shall remain open for inspection by Owner's Representative.

H. Backfill and compact the tank and pipe excavations consistent with Section MDOT 205, Roadway Earthwork.

I. Cease operations and notify the Owner's Representative immediately if adjacent structures appear to be endangered. Do not resume operations until corrective measures are taken, and written approval is received by the Owner's Representative.

J. Except where noted otherwise, immediately remove demolished material from site.

K. Do not burn or bury materials on site.

L. Excavate, segregate, stockpile, and protect soils with evidence of possible petroleum contamination (by visible staining, odors, or by the readings on the Environmental Consultant's field instrumentation).
1. Such soils shall be placed on poly sheeting (6-mil minimum) bermed to prevent run-off, covered with same type of poly to keep precipitation off of the staged soil, and the cover shall be secured to keep the pile dry.

M. Remove and properly dispose of all tank fluids. Remove underground tank, components, and piping.

N. Clean tank, components, and piping in accordance with applicable regulations and remove tank, components, and piping from site.

O. Assist the Environmental Consultant with sampling of soils in the proximity of the tanks. Provide excavator with bucket for gathering samples; decontaminate bucket prior to collecting each sample.

P. Backfill and compact additional areas excavated to remove of petroleum-contaminated soils, as directed by the Owner's Representative.

Q. Rough grade, and compact areas affected by underground storage tank removals in accordance with Section MDOT 205, Roadway Earthwork.

R. Dispose of removed materials from the site as Work progresses. Leave site in clean condition.

S. Dispose of all wastewater off-site in accordance with applicable federal, state, and local regulations.

T. Stockpile petroleum-contaminated soil encountered during the work.

U. Coordinate with the Owner's Representative and Environmental Consultant in providing soil samples for lab testing and analysis by Environmental Consultant.

V. Submit waste disposal documents. Organize and index records, and include the following:
1. Waste characterization and waste profiles submitted to each permitted disposal facility. Include documentation of waste stream acceptance by the disposal facility.

2. Bills of lading or receipts or certifications and weigh tickets generated during the handling and disposal process.
3. Copies of all written approvals from duly authorized persons and agencies for the discharge of wastewater, where allowed, into storm or sanitary sewer systems, onto the ground, or into the groundwater.
4. Copies of permits for waste haulers used in the work, with a separate listing of the material hauled by each entity listed and the final disposal locations of each waste material removed from the site.

3.04 UST CLEANING

A. Conduct tank cleaning procedures in accordance with API Recommended Practice 1604.

B. Measure levels of combustible vapors and oxygen with a Combustible Gas Indicator (CGI), and initiate ventilation of the tank, if needed:
1. Ventilate tank using a small gas exhauster until the vapor concentration is reduced to 10 percent or less of the lower explosive limit (LEL).
2. Oxygen content shall range from 19.5 to 23.5 percent.

C. Ensure final vapor and oxygen concentrations are within the requirements noted above before proceeding to cut and dismantle the tank for its disposal.

D. Cut openings in tank to facilitate tank cleaning after vapor and oxygen concentrations have been met.
1. Total surface area of holes cut into tank shall be minimum of 2% of total surface area of tank, or a minimum of 9 square feet each opposite side or end.
2. Maintain a minimum of two fire extinguishers on-site during cutting of tank.

E. Perform tank cleaning activities twenty-four hours of tank removal from excavation site.

F. Tank Cleaning: Include mopping, scraping and sweeping the interior of the tank. If applicable, comply with OSHA’s confined space entry regulations.

G. Collect, contain and place residuals in a United States Department of Transportation approved drum for transporting and disposal.

3.05 CONTAMINATED MATERIAL DISPOSAL DOCUMENTATION

A. Submit contaminated material disposal documentation prior to payment of any units involving disposal of contaminated materials.

B. Bids shall include “Segregation, Staging, Sampling & Analysis, Transportation, and Disposal of Petroleum-Contaminated Soil.” Provide a price per ton for this item.

C. Bids shall include “Removal, Storage, Sampling & Analysis, Transportation, and Disposal of Petroleum-Contaminated Water.” Provide a price per gallon for this item.

3.06 DISPOSAL OF TANKS AND PIPING

A. Dispose of tanks and all removed appurtenances from the premises as quickly as possible, preferably the same day as removed from the excavation.

B. Legally dispose or recycle the removed tanks and appurtenances in accordance with all local, state and federal regulations.

C. Obtain disposal facility receipts noting proper tank and cleaning material disposal. Submit receipts to the Owner's Representative.

END OF SECTION

SECTION 02 65 01
CHEMICAL STORAGE TANK REMOVALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Transfer all remaining product (chemical) above the low draw-off point (assumed to be 3-inches) to the new aboveground storage tank (AST) containing the same product as directed by the Owner's Representative.

B. Remove and dispose of all remaining product and tank bottoms (heel). This includes product, sludge, sediment, etc.

C. Remove five (5) chemical aboveground storage tanks (ASTs) and chemical transfer systems located in the former fuel facility area.

1.02 SUBMITTALS

A. Submittals shall be provided prior to the commencement of work described in this specification. Provide the following submittals:

(a) Removal procedures and schedule.

(b) Plan of Operations:

1. Include, at a minimum, a description of project approach covering methods for transfer of product, and removal and disposal of all wastes (including tanks, remaining contents, cleaning liquids/materials, etc.). Additionally, the Plan of Operations shall include:
    a. Description of product transfer method from existing ASTs to new ASTs.
    b. Description of the waste segregation and staging methods to be used for tank contents, cleaning liquids/materials, and spent personal protective equipment (PPE).
    c. Methods to be used for cleaning of tank and piping.
    d. Identification of all waste transporters and disposal facilities including copies of all required certifications and permits.
    e. Required certifications and permits including copies of valid permits for all waste haulers, disposal sites, and weigh scales.
2. Tank contents includes potassium acetate solution (50%), which shall be managed as non-hazardous waste. The contents of the tanks cannot be discharged onsite.
3. Submit at a minimum of two (2) weeks prior to commencing work.
4. Waste shall include, but not be limited to tanks, piping, transfer equipment, concrete pads, tank contents, cleaning liquids/materials, and used personal protective equipment.
5. Notify the Owner's Representative within 14 days of the planned closure and removal of the tanks.

(c) Record Documents:

1. Provide meter readings of the volume in gallons of all product transferred from the existing ASTs to the new ASTs.
2. Completed manifests or bills of lading accounting for all materials removed from the site.
3. Waste hauler permit.
4. Waste profile submitted to the disposal facility.
5. Disposal facility's acceptance/approval letter.

(d) A Health and Safety Plan (HASP) must be prepared and implemented for the project, which will be maintained on-site and adhered to for the duration of the work. The Contractor's on-site workers must each hold training certification under OSHA Hazwoper Health and Safety regulations from 29 CFR 1910.120, appropriate to the level of work the individual is performing or managing on site. The HASP must address regulations for confined space entry (29 CFR 1910.146), applicable portions of 29 CFR 1926, exposure to contaminated materials, safety around construction equipment, and any other health and safety precautions required to perform the work. The HASP shall identify personal protective equipment (PPE), decontamination procedures, and exclusion/transition/decontamination zones. The Owner's Representative will review and comment on the HASP but will neither approve nor disapprove it.

(e) Confined Space Entry Permit and the worker training certificates required to clean out the tanks.

(f) Provide copies of the records / documents required herein.

1.03 REQUIRED CERTIFICATIONS AND LICENSES

A. Employees involved in waste operations shall have been trained in accordance with OSHA Final Standards to Protect Workers in Hazardous Waste Operations 29 CFR 1910.120 or most recent revision thereof.

(a) Waste haulers shall maintain a valid transporter permit.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02 41 19 "Selective Demolition."

B. Section 26 00 10 "Electrical General Requirements."

1.04 REGULATORY REQUIREMENTS

A. Abide by all applicable rules and regulations, including but not limited to the following:

(a) Applicable OSHA worker safety regulations.
(b) State, county, and federal regulations pertaining to the handling, storage, transport, and disposal of wastes generated during the project.
(c) Coordinate and obtain all permits as required by permitting authorities.

1.05 ABBREVIATIONS

A. The following terms shall have the meanings ascribed to them in this Section, wherever they appear in this Section.

(a) AST: Aboveground Storage Tank.
(b) HASP: Health and Safety Plan.
(c) EGLE: Michigan Department of Environment, Great Lakes, and Energy.
(d) NFPA: National Fire Protection Association.
(e) OSHA: Occupational Safety and Health Administration.
(f) PPE: Personal Protective Equipment.
(g) USDOT: United States Department of Transportation.
(h) USEPA: United States Environmental Protection Agency.

1.06 NOTIFICAITON

A. Notify (in writing) the Owner's Representative at least 48 hours prior to beginning closure operations at the tanks.
(a) If contaminated soils are encountered, the Contractor shall notify the Owner's Representative within one-hour of discovery.

1.07 EXISTING CONDITIONS

A. Protect and safeguard from damage all existing buildings, structural systems, fencing, equipment, and surfaces that will remain. Contractor shall repair any damage to structures, appurtenances or the landscape not scheduled for removal work.

B. Remove and dispose of the following chemical storage tanks. Assume product will be removed to the low draw-off point.

ORIENTATION	CONSTRUCTION	DESIGN CAPACITY (GALLONS)	PRODUCT	ASSUMED HEEL* (GALLONS)
Vertical	Single-wall Fiberglass-Reinforced Plastic AST	Est. 30,000	Potassium Acetate Solution (50%)	250
Horizontal	Double-wall steel; Painted (grey) AST	10,000	Potassium Acetate Solution (50%)	100
Vertical	High-Density Polyethylene; (white) AST	Est. 15,000	Potassium Acetate Solution (50%)	325
Vertical	High-Density Polyethylene; (blue) AST	Est. 5,000	Potassium Acetate Solution (50%)	150
Vertical	High-Density Polyethylene; (blue) AST	Est. 5,000	Potassium Acetate Solution (50%)	150

* Heel is hereby defined as the product remaining below the low draw-off point (assumed to be 3-inches). For purposes of this definition, remaining product includes product, sludge, sediment, etc.

PART 2 - PRODUCTS

2.01 Drums.

A. Provide USDOT approved drums, if necessary.

PART 3 - EXECUTION

3.01 Preparation.

A. Prepare the site as follows:
(a) Locate and clearly mark all subsurface utilities in the area of excavation. Conduct activities to minimize interference with, and to protect the existing surfaces of, adjacent structures or utilities.
(b) Provide, erect, and maintain temporary barriers and security devices.
(c) Conduct operations with no interference to public or private thoroughfares.
(d) Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

(e) Remove and dispose of abandoned conduit or piping within excavated areas and plug ends.
1. Identify disconnection locations on Project Record Documents.
(f) Perform tank removal in a manner that will minimize dust, noise, and other nuisance.
(g) Maintain haul routes for disposal of material clean and free of debris.
(h) Provide monitoring equipment at site as required by the Site Health and Safety Plan. Operate and maintain in accordance with manufacturer's recommendations.
(i) Perform the Work with consideration for facility personnel and the public. Maintain barriers between work areas and adjacent facilities at all times, with necessary signs, lights, bracing and guards for the protection of all facility personnel, the public, and existing facilities.
(j) Schedule the Work in advance with the Owner's Representative to coordinate work schedules.

3.02 Storage Tank Liquid Transfer, Removal and Disposal.

A. Transfer all product above the low draw-off point to the new AST containing the same product.
(a). The Contractor shall submit a price per gallon in their bid for this effort.
(b). Provide meter readings of the volume in gallons of all product transferred from the existing ASTs to the new ASTs.
B. Remove liquids from the storage tanks as follows:
(a) Prior to removal of a tank, empty the tank so that there are no visible contents or residue as follows:
(b) Drain and flush piping into the tank.
(c) Remove all product to its lowest draw-off point.
(d) Pump out the liquid below the draw-off point (tank bottom).
(e) Use an explosion-proof hand or vacuum pump.
(f) Pump out the entire tank bottom including the remaining product layer.
(g) Bond equipment to tank and ground tank to a separate ground when purging tank with compressed air or inert gas under pressure.
(h) Tank contents shall be properly disposed of in accordance with EGLE and local and federal regulations.
(i) Provide proof of proper disposal to Engineer.

3.03 Tank and Piping Removal.

A. Remove tanks and piping as follows:
(a) Disconnect piping, gauge, and all other tank fixtures, except the vent line.
(b) Plug all tank openings.
(c) Spills or drips shall be contained to prevent contamination of soils during removal.
(d) Except where noted otherwise, immediately remove demolished material from site.
(e) Do not burn or bury materials on site.
(f) Remove and properly dispose of all tank fluids. Remove tank, components, and piping.
(g) Clean tank, components, and piping in accordance with applicable regulations and remove tank, components, and piping from site.
(h) Dispose of removed materials from the site as Work progresses. Leave site in clean condition.
(i) Dispose of all cleaning liquid/materials off-site in accordance with applicable federal, state, and local regulations.
(j) Submit waste disposal documents. Organize and index records, and include the following:
1. Waste characterization and waste profiles submitted to each permitted disposal facility. Include documentation of waste stream acceptance by the disposal facility.

2. Bills of lading or receipts or certifications and weigh tickets generated during the handling and disposal process.
3. Copies of waste hauler permits used in the work, with a separate listing of the material hauled by each entity listed and the final disposal locations of each waste material removed from the site.

3.04 Tank Cleaning.

A. Clean tank interiors as follows:
(a) Measure levels of oxygen with a Combustible Gas Indicator (CGI), and initiate ventilation of the tank, if needed:
1. Ventilate tank using a small gas exhauster until the vapor concentration is reduced to 10 percent or less of the lower explosive limit (LEL).
2. Oxygen content shall range from 19.5 to 23.5 percent.

(b) Ensure final vapor and oxygen concentrations are within the requirements noted above before proceeding to cut and dismantle the tank for its disposal.

(c) Cut openings in tank to facilitate tank cleaning after vapor and oxygen concentrations have been met.
1. Total surface area of holes cut into tank shall be minimum of 2% of total surface area of tank, or a minimum of 9 square feet each opposite side or end.
2. Maintain a minimum of two fire extinguishers on-site during cutting of tank.

(d) Perform tank cleaning activities within twenty-four (24) hours of tank removal.

(e) Tank Cleaning: Include mopping, scraping and sweeping the interior of the tank. If applicable, comply with OSHA's confined space entry regulations.

(f) Collect, contain and place residuals in a USDOT approved drums for transporting and disposal.

3.05 Contaminated material disposal documentation.

A. Document contaminated material disposal as follows:
(a) Submit contaminated material disposal documentation.

3.06 Disposal of tanks and piping.

A. Dispose of tanks and piping as follows:
(a) Dispose of tanks and all removed appurtenances from the premises as quickly as possible, preferably the same day as removed.

(b) Legally dispose, scrap, or recycle the removed tanks and appurtenances in accordance with all local, State and Federal regulations.

(c) Recycle clean concrete.

(d) Obtain disposal facility receipts noting proper tank and cleaning material disposal. Submit receipts to the Engineer.

END OF SECTION

SECTION 031000
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Form liners.
3. Insulating concrete forms.
4. Shoring, bracing, and anchoring.

1.3 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction, movement, contraction, and isolation joints
c. Forms and form-removal limitations.
d. Shoring and reshoring procedures.
e. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.

3. Forms for cylindrical columns.
4. Void forms.
5. Form ties.
6. Waterstops.
7. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

    a. Location of construction joints is subject to approval of the Architect.

3. Indicate location of waterstops.
4. Indicate form liner layout and form line termination details.
5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
6. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

C. Samples:

1. For waterstops.
2. For Form Liners: 12-inch by 12-inch sample, indicating texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Form Liners: Store form liners under cover to protect from sunlight.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

a. Plywood, metal, or other approved panel materials.
b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

1) APA HDO (high-density overlay).
2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces **without spiral or vertical seams** not exceeding specified formwork surface class.

1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

2.3 WATERSTOPS

A. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
   1. Profile: Flat dumbbell with center bulb.
   2. Dimensions: 4 inches by 3/16 inch thick, nontapered.

B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

2.4 RELATED MATERIALS

A. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

   1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. **Chamfer** exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

    a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

6. Space vertical joints in walls as indicated on Drawings.

    a. When not shown on drawings locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
4. Secure waterstops in correct position at 12 inches on center.
5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.

    a. Miter corners, intersections, and directional changes in waterstops.
    b. Align center bulbs.

6. Clean waterstops immediately prior to placement of concrete.
7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.4 INSTALLATION OF INSULATING CONCRETE FORMS

A. Comply with ACI 301 and manufacturer's instructions.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Install forms in running bond pattern.

1. Align joints.
2. Align furring strips.

D. Construct forms tight to prevent loss of concrete mortar.

E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

3.5 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F

for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

SECTION 032000
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete”.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Epoxy repair coating.
3. Zinc repair material.
4. Bar supports.
5. Mechanical splice couplers.
6. Structural thermal break insulated connection system.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of the Architect.

D. Delegated-Design Submittal: For structural thermal break insulated connection system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For testing and inspection agency.

B. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M

C. Material Certificates: For each of the following, signed by manufacturers:

1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
2. Dual-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."

D. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.
2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Low-Alloy Steel Reinforcing Bars: ASTM A706, deformed.

C. Headed-Steel Reinforcing Bars: ASTM A970.

D. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615, Grade 60, deformed bars, assembled with clips.

E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

F. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced.

D. Steel Tie Wire: ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

E. Zinc Repair Material: ASTM A780.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install structural thermal break insulated connection system in accordance with manufacturer's instructions.

H. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel-reinforcement placement.
2. Steel-reinforcement mechanical splice couplers.

D. Manufacturer's Inspections: Engage manufacturer of structural thermal break insulated connection system to inspect completed installations prior to placement of concrete, and to provide written report that installation complies with manufacturer's written instructions.

END OF SECTION 032000

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SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.

2. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction joints, control joints, isolation joints, and joint-filler strips.
c. Semirigid joint fillers.
d. Vapor-retarder installation.
e. Anchor rod and anchorage device installation tolerances.
f. Cold and hot weather concreting procedures.
g. Concrete finishes and finishing.
h. Curing procedures.
i. Forms and form-removal limitations.
j. Shoring and reshoring procedures.
k. Methods for achieving specified floor and slab flatness and levelness.
l. Floor and slab flatness and levelness measurements.
m. Concrete repair procedures.
n. Concrete protection.
o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
p. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Performance-based hydraulic cement
6. Aggregates.
7. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
8. Fiber reinforcement.
9. Vapor retarders.
10. Curing materials.

    a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

11. Joint fillers.
12. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.

8. Nominal maximum aggregate size.
9. Steel-fiber reinforcement content.
10. Synthetic micro-fiber content.
11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
14. Intended placement method.
15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

    a. Location of construction joints is subject to approval of the Architect.

D. Samples: For vapor retarder.

E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Location within Project.
2. Formed Surface Finish designation and final finish.
3. Final finish for floors.
4. Curing process.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Bonding agents.
6. Adhesives.
7. Vapor retarders.
8. Semirigid joint filler.
9. Joint-filler strips.
10. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.

2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Performance-based hydraulic cement.
6. Aggregates.
7. Admixtures:

    a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.
f. Permeability.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
2. Fly Ash: ASTM C618, Class F, 20% maximum by weight.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120, 25% maximum by weight.

C. Normal-Weight Aggregates: ASTM C33/C33M, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

2. Maximum Coarse-Aggregate Size: 1 inch nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C330/C330M, 1-inch nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C260/C260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

G. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4

2.3 FIBER REINFORCEMENT

1. Syntehtic Fiber: Provide fiber reinforcement for composite slab and wearing surface Fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C1116, Type III, 1" to 2" long. Provide one of the following or approved equal:

   a. "Tuf-strand SF"; (Euclid Chemical Company)
   b. "Fibermesh 650"; (Propex Operating Company)
   c. "Grace Fibers"; (WR Grace & Co.)

B. VAPOR RETARDERS

C. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Poly-America, L.P.
2. Stego Industries, LLC.
3. W. R. Meadows, Inc.

2.4 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Water: Potable or complying with ASTM C1602/C1602M.

D. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

E. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. Types I and II, nonload bearing, Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.6 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 20 percent by mass.
2. Slag Cement: 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete and concrete with a w/cm below 0.50.

2.8 CONCRETE MIXTURES

A. Class **A**: Normal-weight concrete used for footings and foundation walls.

1. Exposure Class: ACI 318 (ACI 318M) F1.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Air Content:

    a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size, 4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.

B. Class B: Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 W0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 520 lb/cu. yd.
5. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
6. Air Content:

    a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.

7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.5 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Locate joints for beams and slabs at third points of spans.
5. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

   a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
   b. Remove projections larger than 1 inch.
   c. Tie holes do not require patching.
   d. Surface Tolerance: ACI 117 Class D.
   e. Apply to concrete surfaces foundations and foundation walls not exposed to view.

2. ACI 301 Surface Finish SF-3.0: Exposed to view

   a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
   b. Remove projections larger than 1/8 inch.
   c. Patch tie holes.
   d. Surface Tolerance: ACI 117 Class A.
   e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

   a. Perform no later than one day after form removal.
   b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
   c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
   d. Maintain required patterns or variances as shown on Drawings or to match design reference sample.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
3. Apply scratch finish to surfaces to receive concrete floor toppings, to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

    a. Slabs on Ground:
        1. Specified overall values of flatness, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 17; and of levelness, F_L 15.

    b. Slabs on metal deck:
        1. Specified overall values of flatness, F_F 20.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1,) before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
b. Continuous Sprinkling: Maintain concrete surface continuously wet.
c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

1. Recoat areas subject to heavy rainfall within three hours after initial application.
2. Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

1. Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12-inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1. Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Curing Compound:

1. Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2. Recoat areas subjected to heavy rainfall within three hours after initial application.
3. Maintain continuity of coating, and repair damage during curing period.
4. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

d. Floors to Receive Curing and Sealing Compound:

1. Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2. Recoat areas subjected to heavy rainfall within three hours after initial application.
3. Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

A. Conform to ACI 117.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than **28** days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least **one** month.
2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

   a. Limit cut depth to 3/4 inch.
   b. Make edges of cuts perpendicular to concrete surface.
   c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
   d. Fill and compact with patching mortar before bonding agent has dried.
   e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

a. Correct low and high areas.
b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
d. Place, compact, and finish to blend with adjacent finished concrete.
e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
b. Dampen cleaned concrete surfaces and apply bonding agent.
c. Place patching mortar before bonding agent has dried.
d. Compact patching mortar and finish to match adjacent concrete.
e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Contractor will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

1. Project name.
2. Name of testing agency.
3. Names and certification numbers of field and laboratory technicians performing inspections and testing.
4. Name of concrete manufacturer.
5. Date and time of inspection, sampling, and field testing.
6. Date and time of concrete placement.
7. Location in Work of concrete represented by samples.
8. Date and time sample was obtained.
9. Truck and batch ticket numbers.
10. Design compressive strength at 28 days.
11. Concrete mixture designation, proportions, and materials.
12. Field test results.
13. Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14. Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

3. Slump Flow: ASTM C1611/C1611M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure two sets of four 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
    b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
    b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
    c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.

11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

12. Additional Tests:

    a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

        1. Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.

13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

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SECTION 042000
UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout materials.
3. Reinforcement.
4. Ties and anchors.
5. Embedded flashing.
6. Mortar and grout mixes.

B. Related Requirements:

1. Section 072100 "Thermal Insulation" for cavity wall insulation.
2. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Decorative CMUs, in the form of small-scale units.
2. Weep/cavity vents.

D. Samples for Verification: For each type and color of the following:

1. Decorative CMUs.
2. Pigmented, and, colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Weep/cavity vents.
4. Cavity drainage material.
5. Accessories embedded in masonry.

1.5 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Material Certificates: For each type of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.

2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.

E. Cold-Weather, and,Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.
2. Delegated Design Engineer: A professional engineer who is legally qualified to practice in Michigan where Project is located and who is experienced in providing engineering services of the type indicated.
3. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

1.7 MOCKUPS

A. Wall Mockups: Build mockups to verify selections made under Sample submittals,and, to set quality standards for installation. See Section 014339 "Mockups" for additional construction requirements for integrated exterior mockups.

1. Build mockup as indicated on Drawings.
2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations by Change Order.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of **24 inches** down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of **24 inches** down face next to unconstructed wythe, and hold

cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is **40 deg F** and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain from single source,or, manufacturer.

B. For exposed masonry units, and, cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units are listed by UL or a qualified testing agency acceptable to authorities having jurisdiction.

2.3 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within **500 miles** of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site.

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

C. CMUs: ASTM C90, medium weight, unless otherwise indicated.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Size (Width): Manufactured to dimensions **3/8 inch** less than nominal dimensions.
3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
4. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

D. Decorative CMUs: ASTM C90, normal weight.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Trendstone CMU, from Echelon or comparable product by one of the following:

    a. York Building Products

2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph above.
4. Pattern and Texture: Standard pattern, split-face finish.
5. Colors: As selected by Architect from manufacturer's full range.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

2.4 LINTELS

A. Solid Concrete Masonry Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength of not less than that of CMUs.

B. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 032000 "Concrete Reinforcing," and with reinforcing bars indicated.

C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and

installing. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be manufactured within **500 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site.

B. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

C. Hydrated Lime: ASTM C207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Manufacturers: Subject to compliance with requirements, :

a. Davis Colors
b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
c. Lanxess Corporation
d. Solomon Colors Inc.

F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
2. Pigments do not exceed 10 percent of portland cement by weight.

G. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime or mortar cement, sand, mortar pigments, and admixtures and complying with ASTM C1714/C1714M.

H. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than **1/4 inch** thick, use aggregate graded with 100 percent passing the **No. 16** sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C404.

J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ACM Chemistries
b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
c. GCP Applied Technologies Inc.
d. Master Builders Solutions; brand of MBCC Group

K. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, **Grade 60**.

B. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls: Mill- galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.187-inch diameter.
5. Wire Size for Veneer Ties: 0.187-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than **16 inches** o.c.
7. Provide in lengths of not less than **10 ft.**, with prefabricated corner and tee units.

C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder[**or truss**] type with single pair of side rods.

1. Manufacturers: Subject to compliance with requirements, :

a. Hohmann & Barnard, Inc
b. Wire-Bond

2.7 TIES AND ANCHORS

A. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a **100 lbf** load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of **1/16 inch**.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.1084-inch-thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
5. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie and washer at face of insulation.

a. Manufacturers: Subject to compliance with requirements, provide products by one

of the following:

1) FERO Corporation
2) Hohmann & Barnard, Inc
3) PROSOCO, Inc
4) Wire-Bond

6. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, **No. 10** diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours in accordance with ASTM B117.
7. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, **No. 10** diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless steel shank.

2.8 EMBEDDED FLASHING

A. Metal Flashing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cheney Flashing Company
   b. Hohmann & Barnard, Inc
   c. Keystone Flashing Company, Inc

2. General: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

   a. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, **0.016 inch** thick.
   b. Copper: .
   c. Fabricate continuous flashings in sections **96 inches** long minimum, but not exceeding **12 ft.**. Provide splice plates at joints of formed, smooth metal flashing.
   d. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with sawtooth ribs at **3-inch** intervals along length of flashing to provide an integral mortar bond.
   e. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
   f. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing **1/2 inch** out from wall, with outer edge bent down 30 degrees and hemmed.
   g. Fabricate metal drip edges and sealant stops for sawtooth metal flashing from plain metal flashing of same metal as sawtooth flashing and extending at least **3 inches** into wall with hemmed inner edge to receive sawtooth flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.
   h. Fabricate metal drip edges from stainless steel. Extend at least **3 inches** into wall and **1/2 inch** out from wall, with outer edge bent down 30 degrees[**and hemmed**].
   i. Fabricate metal sealant stops from stainless steel. Extend at least **3 inches** into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for **3/4 inch** and down into joint **1/4 inch** to form a stop for retaining sealant

backer rod.

j. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.

k. Solder metal items at corners.

B. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.

1. Manufacturers: Subject to compliance with requirements, :

a. Mortar Net Solutions

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

D. Termination Bars for Flexible Flashing: Stainless steel bars 1/8 inch by 1 inch.

E. Termination Bars for Flexible Flashing, Flanged: Stainless steel sheet 0.019 inch by 1-1/2 inches with a **3/8-inch** flange at top and bottom.

2.9 ACCESSORIES

A. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

B. Weep/Cavity Vents: Use one of the following unless otherwise indicated:

1. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, **3/8 by 1-1/2 by 3-1/2 inches** long.
2. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth **1/8 inch** less than depth of outer wythe, in color selected from manufacturer's standard.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Advanced Building Products Inc.: Mortar Maze Weep Vent
2) Wire-Bond: Cell Vent (#3601)

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior nonload-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments do not exceed 10 percent of portland cement by weight.
2. Mix to match Architect's sample.
3. Application: Use pigmented mortar for exposed mortar joints with the following units: Decorative CMU.

E. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1.
3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus **1/2 inch** or minus **1/4 inch**.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus **1/2 inch**.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus **1/4 inch** in a story height or **1/2 inch** total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than **1/4 inch in 10 ft.**, or **1/2-inch** maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than **1/8 inch in 10 ft.**, **1/4 inch in 20 ft.**, or **1/2-inch** maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than **1/4 inch in 10 ft.**, **3/8 inch in 20 ft.**, or **1/2-inch** maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than **1/8 inch in 10 ft.**, **1/4 inch in 20 ft.**, or **1/2-inch** maximum.
5. For lines and surfaces, do not vary from straight by more than **1/4 inch in 10 ft.**, **3/8 inch in 20 ft.**, or **1/2-inch** maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than **1/4 inch in 10 ft.**, or **1/2-inch** maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than **1/16 inch** except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus **1/8 inch**, with a maximum thickness limited to **1/2 inch**.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more

than **1/8 inch**.

3. For head and collar joints, do not vary from thickness indicated by more than plus **3/8 inch** or minus **1/4 inch**.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus **1/8 inch**. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than **1/16 inch** from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal **4-inch** horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal **4-inch** horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout **24 inches** under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide **1/2-inch** clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

3.5 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of **5/8 inch** on exterior side of walls, **1/2 inch** elsewhere. Lap reinforcement a minimum of **6 inches**.

1. Space reinforcement not more than **16 inches** o.c.
2. Space reinforcement not more than **8 inches** o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than **8 inches** above and below wall openings and extending **12 inches** beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than **24 inches** o.c. vertically and **36 inches** o.c. horizontally.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete,or, offset angle support lintels where indicated and where openings of more than **12 inches** for brick-size units and **24 inches** for block-size units are indicated without structural steel or other supporting lintels.

C. Provide minimum bearing of **8 inches** at each jamb unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches, and through inner wythe to within **1/2 inch** of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately **2 inches** on interior face.
3. At lintels and shelf angles, extend flashing **6 inches** minimum, to edge of next full unit at each end. At heads and sills, extend flashing **6 inches** minimum, to edge of next full unit and turn ends up not less than **2 inches** to form end dams.
4. Interlock end joints of sawtooth sheet metal flashing by overlapping ribs not less than **1-1/2 inches** or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
5. Install metal drip edges, and, sealant stops with sawtooth sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch** back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
7. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch** back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.

E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes formed from plastic tubing, or, wicking material **16 inches** o.c.
4. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
5. Trim wicking material flush with outside face of wall after mortar has set.

F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than **2 inches**, to maintain drainage.

1. Fill cavities full height by placing pea gravel in cavities as masonry is laid, so that at any point, masonry does not extend more than **24 inches** above top of pea gravel.

G. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Accessories" Article.

H. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.

D. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

E. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content, and, compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

G. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 7 days and at 28 days.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.12 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than **4 inches** in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within **18 inches** of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 054000
COLD-FORMED METAL FRAMING

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Floor joist framing.

B. Related Requirements:

   1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.

5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Evaluation Reports: For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180)

B. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 1-3/8 inches (35 mm) (minimum)

C. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs
2. Flange Width: 1-1/4 inches (32 mm)

2.3 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

2.4 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts,carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on

ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Torque-controlled adhesive anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780/A 780M

B. Cement Grout: Portland cement, ASTM C 150/C 150M, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.6 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:

1. Joist Spacing: As indicated on Drawings

D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.5 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.6 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Shelf angles.
3. Structural-steel door frames.
4. Miscellaneous steel trim.
5. Metal bollards.
6. Pipe and downspout guards.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Fasteners.
2. Slotted channel framing.
3. Metal bollards.
4. Pipe and downspout guards.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Prefabricated building columns.
3. Shelf angles.

4. Metal floor plate and supports.
5. Structural-steel door frames.
6. Miscellaneous steel trim including steel angle corner guards, steel edgings.
7. Metal bollards.
8. Loose steel lintels.
9. Vehicular barrier cable systems.

1.4 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research Reports: For post-installed anchors.

E. Delegated design engineer qualifications.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials

without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Aluminum Plate and Sheet: **ASTM B209**, Alloy 6061-T6.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum, stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, **ASTM A307, Grade A**; with hex nuts, **ASTM A563**; and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325**, Type 3, heavy-hex steel structural bolts; **ASTM A563, Grade DH3,** heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, **ASTM F593**; with hex nuts, **ASTM F594**; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, **ASTM A563**; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

G. Post-Installed Anchors: chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, **ASTM F593**, and nuts, **ASTM F594**.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of **3000 psi**.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch** unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, **1/8 by 1-1/2 inches**, with a minimum **6-inch** embedment and **2-inch** hook, not less than **8 inches** from ends and corners of units and **24 inches** o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise

indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive **3/4-inch** bolts, spaced not more than **6 inches** from ends and **24 inches** o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately **2 inches** larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize and prime shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 STRUCTURAL-STEEL DOOR FRAMES

A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with **5/8-by-1-1/2-inch** steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than **10 inches** o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.

1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

C. Galvanize and prime, exterior steel frames.

D. Prime exterior steel frames with zinc-rich primer.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime, exterior miscellaneous steel trim.

D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.10 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

B. Fabricate bollards with **3/8-inch-** thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for **3/4-inch** anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe with **1/4-inch-** thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than **8 inches** deep and **3/4 inch** larger than OD of bollard.

D. Prime steel bollards with zinc-rich primer.

2.11 PIPE AND DOWNSPOUT GUARDS

A. Fabricate pipe, downspout guards from **3/8-inch-** thick by **12-inch-** wide, stainless steel, ASTM A480/A480M, No. 4 finish plate, bent to fit flat against the wall or column at both ends and to fit around pipe with **2-inch** clearance between pipe and pipe guard. Drill each end for two **3/4-inch** anchor bolts.

B. Galvanize and prime steel pipe, downspout guards.

2.12 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than **8 inches** unless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.13 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.14 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.16 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for overhead doors, and, overhead grilles securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction with anchor bolts.

D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders

with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLATION OF SHELF ANGLES

A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

3.4 INSTALLATION OF STRUCTURAL-STEEL DOOR FRAMES

A. Fasten structural steel door frames to the floor slab by means of angle clips and expansion bolts. Anchor door jambs to adjacent construction in accordance with shop drawing details.

3.5 INSTALLATION OF MISCELLANEOUS STEEL TRIM

A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.6 INSTALLATION OF METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1. Do not fill removable bollards with concrete.

B. Anchor bollards to existing construction with expansion anchors. Provide four **3/4-inch** bolts at each bollard unless otherwise indicated.

1. Embed anchor bolts at least **4 inches** in concrete.

C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately **1/8 inch** toward bollard.

D. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.7 INSTALLATION OF PIPE AND DOWNSPOUT GUARDS

A. Provide pipe guards at exposed vertical pipes in at locations indicated on Drawings where not

protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four **3/4-inch** bolts at each pipe guard. Mount pipe guards with top edge **26 inches** above driving surface.

3.8 INSTALLATION OF CAST-IRON WHEEL GUARDS

A. Anchor wheel guards to concrete or masonry construction to comply with manufacturer's written instructions. Fill cores solidly with concrete.

3.9 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum **2.0-mil** dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Miscellaneous lumber.
3. Plywood backing panels.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than **2 inches nominal** size in least dimension.

B. Dimension Lumber: Lumber of **2 inches nominal** size or greater but less than **5 inches nominal** size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 19 percent.
2. Dimension Lumber: 19 percent unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.
4. Furring.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.3 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.4 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to

penetrate not less than **1-1/2 inches** into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

2.5 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:

1. Closed-cell neoprene foam, **1/4 inch** thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than **0.025 inch**.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

F. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

G. Do not splice structural members between supports unless otherwise indicated.

H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than **16 inches** o.c.

I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than **96 inches** o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than **96 inches** o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and **2-inch nominal** thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than **100 sq. ft.** and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than **20 feet** o.c.

J. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

K. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

L. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).

N. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with

surfaces unless otherwise indicated.

3.3 INSTALLATION OF WOOD FURRING

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install **1-by-3-inch nominal-** size furring horizontally, and, vertically at 24 inches o.c.

END OF SECTION 061000

SECTION 072100
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 THERMAL INSULATION

A. Unfaced Metal Building Insulation: ASTM C991, Type 1, or NAIMA 202, glass-fiber-blanket insulation; .5-lb/cu. ft. (8-kg/cu. m) density; with a flame-spread index of 25 or less.

1. Basis of Design Manufacturer: Subject to compliance with requirements, provide Thermal Design, Simple Saver System for New Pre-Engineered Metal Buildings, or approved equal.
2. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm (1.15 ng/Pa x s x sq. m) when tested according to ASTM E 96/E 96m, Desiccant Method.

a. Composition: White polyethylene film facing and woven reinforced high-density polyethylene yarn backing.

B. Retainer Strips: 0.02-inch nominal-thickness by 1 inch wide by continuous length 100 KSI minimum yield high tensile strength steel, galvanized, primed, and painted to match insulation facing.

C. Fasteners: #12 by 1-1/4 inch plated self drilling screws, painted to match retainer strip color .

D. Insulation Hangers: Insulation hangers recommended by insulation system manufacturer to support insulation between wall girts.

E. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 75 and 450 when tested in accordance with ASTM E84.

B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Labeling: Provide identification of mark indicating R-value of each piece of insulation **12 inches** and wider in width.

E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.3 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, **25-psi** minimum compressive strength; unfaced.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. DiversiFoam Products
    b. Kingspan Insulation LLC
    c. Owens Corning
    d. Owens Corning: Owens Corning® THERMAPINK® NGX™ Extruded Polystyrene Insulation
    e. The Dow Chemical Company

2.4 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Thermal Design Inc. Simple Saver System or comparable product by one of the following as approved by architect:

    a. CertainTeed; SAINT-GOBAIN
    b. Knauf Insulation
    c. Owens Corning

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions.
2. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately **24 inches** o.c. both ways on inside face and as recommended by manufacturer.

1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.
3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain **3-inch** clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed **96 inches**, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward as indicated on Drawings.
    b. Interior Walls: Set units with facing placed as indicated on Drawings.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately **2.5 lb/cu. ft.**.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

C. Loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions.

1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
2. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."

D. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation according to manufacturer's written instructions.

1. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
2. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.7 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass.
2. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
3. Install insulation to fit snugly without bowing.

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 074113.13
FORMED METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Corrugated-profile, exposed-fastener metal roof panels.
2. Roof insulation.
3. Cover board.

B. Related Requirements:

1. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.
2. Section 133419 "Metal Building Systems"

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of supporting structure during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For formed metal roof panels. Include construction details, material descriptions,

dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches**.

C. Samples for Initial Selection: Manufacturer's standard color charts, showing full range of available colors for each type of exposed finish.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish for metal panels, clips, fasteners, closures, and other metal panel accessories.

1. Size: 8" X 8".

1.4 INFORMATIONAL SUBMITTALS

A. Certificates for portable roll-forming equipment.

B. Product Test Reports: For formed metal roof panels, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Qualification Statements: For roof installers.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels.

1.6 QUALITY ASSURANCE

A. Roof Installer Qualifications: Entity that employs a supervisor who is an NRCA ProCertified Roofing Foreman or installers who are NRCA ProCertified Metal Panel Roof Systems Installers.

B. Portable Roll-Forming Equipment Certification: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or

deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written installation instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period. Warranty period is 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.04 cfm/sq. ft. when tested in accordance with ASTM E1680 or ASTM E283/E283M at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

C. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

D. Watertightness: No water penetration when tested in accordance with ASTM E2140 for hydrostatic-head resistance.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 60.

F. FM Approvals Listing: Provide metal roof panels and component materials that comply with requirements in FM Approvals 4471 as part of a panel roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A-60.
2. Hail Resistance: MH.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 EXPOSED-FASTENER METAL ROOF PANELS, GENERAL

A. Provide factory-formed metal roof panels designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners.

Include accessories required for weathertight installation.

B. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.

2.3 CORRUGATED-PROFILE, EXPOSED-FASTENER METAL ROOF PANELS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Nucor, color: Light Stone or comparable product by one of the following:

1. CENTRIA, a Nucor Brand
2. Firestone Metal Products
3. PAC-CLAD
4. Varco-Pruden Buildings; a division of BlueScope Buildings North America, Inc.
5. Substitutions: Under provisions of Section 012500

B. Panels: Formed with alternating curved ribs.

1. Structural Support: Over solid deck.
2. Material: Metallic-coated steel.
3. Rib Spacing: 2.67 inches o.c. across width of panel.
4. Panel Coverage: Match existing adjacent.
5. Panel Height: Match existing adjacent..
6. Fasteners: Manufacturer's standard screw fasteners.

2.4 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, **G90** coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, **Class AZ50** coating designation; structural quality. Sheet prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Nominal Thickness: 0.028 inch.

2.5 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, minimum ASTM A653/A653M, **G90** hot-dip galvanized coating designation or ASTM A792/A792M, **Class AZ50** aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system, including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or

closed-cell laminated polyethylene; minimum **1-inch-** thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum **96-inch-** long sections, of size and metal thickness in accordance with manufacturer's recommendations. Furnish gutter supports spaced a maximum of **36 inches** o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.

E. Downspouts: Formed from same material as roof panels. Fabricate in **10-foot-** long sections, complete with formed elbows and offsets, of size and metal thickness in accordance with manufacturer's recommendations. Finish downspouts to match gutters.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

G. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch** wide and **1/8 inch** thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.6 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate in accordance with equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with manufacturer's recommendations.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by metal panel manufacturer for application, but not less than thickness of metal being secured.

2.7 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

C. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch (0.76-mm) nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. a. Exterior Finish: Two-coat fluoropolymer. b. Color: As selected by Architect from manufacturer's full range.

D. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL ROOF PANELS

A. Install metal panels in accordance with manufacturer's written instructions in orientation, sizes, and locations indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that are concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel Work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to exterior; use galvanized-steel fasteners for surfaces exposed to interior.
2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to interior.
3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
4. Stainless Steel Panels: Use stainless steel fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Exposed-Fastener, Metal Roof Panels: Fasten metal panels to supports with fasteners at each

lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.
6. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum **6-inch** end lap, sealed with sealant and fastened together by interlocking clamping plates.

E. Horizontal-Seam (Bermuda-Type) Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each horizontal-seam joint at location and spacing, and with fasteners recommended by manufacturer. Start at eave and work upward toward ridge.

1. Install clips to supports with self-drilling fasteners.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements and manufacturer's written installation instructions. Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that are without buckling and tool marks, and that are true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 ft.**, with no joints allowed within **24 inches** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with mastic sealant (concealed within joints).

H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than **36 inches** o.c., using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely **1 inch** away from walls; locate fasteners at top and bottom and at approximately **60 inches** o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

J. Roof Curbs: Install flashing around bases where they meet metal roof panels.

K. Pipe and Conduit Penetrations: Fasten and seal to metal roof panels as recommended by manufacturer.

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of **1/4 inch in 20 ft.** on slope and location lines and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal panel installation, including accessories. Report results in writing.

B. Remove and replace applications where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.13

SECTION 074213.13
FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exposed-fastener, lap-seam metal wall panels.
2. Metal liner panels.

B. Related Requirements:

1. Section 133419 "Metal Building Systems"

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review of procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1. Exposed-fastener, lap-seam metal wall panels.
2. Metal liner panels.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches**.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.

1. Include Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

1. Metal Panels: **12 inches** long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For exposed-fastener, lap-seam metal wall panels, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal panel assembly as shown on Drawings, including supports, attachments, and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft.** when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

A. Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.

B. Reverse-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with recessed, trapezoidal major valleys and a flat pan between major valleys.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Nucor or comparable product by one of the following:

a. CENTRIA, a Nucor Brand
b. PAC-CLAD
c. Substitutions: Under provisions of Section 012500

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, **G90** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, **Class AZ50** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch.
b. Exterior Finish: Two-coat fluoropolymer.
c. Color: .

2.3 METAL LINER PANELS

A. Provide factory-formed metal liner panels designed for interior side walls and field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for a complete installation.

B. Metal Liner Panels: Solid panels formed with intermediate stiffening ribs symmetrically spaced between panel edges; with a flush joint between panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Nucor or comparable product by one of the following:

a. CENTRIA, a Nucor Brand
b. PAC-CLAD
c. Varco-Pruden Buildings; a division of BlueScope Buildings North America, Inc.
d. Substitutions: Under provisions of Section 012500

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, **G90** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, **Class AZ50** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch.
b. Exterior Finish: Two-coat fluoropolymer.
c. Color: Light Stone and Aztec Blue as indicated on drawings.

3. Panel Coverage: 12 inches.
4. Seam Profile: Flush.
5. Seam Height: 1.5 inches.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, **G90** hot-dip galvanized coating designation or ASTM A792/A792M, **Class AZ50** aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets,

fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch-** thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch** wide and **1/8 inch** thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that

apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** for primer and **0.8 mil** for topcoat.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil**.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or

blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
4. Stainless Steel Panels: Use stainless steel fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for

neat and weathertight enclosure.

2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum **6-inch** end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Metal Liner Panels: Install panels on interior side of girts with flush appearance on the inside.

G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet** with no joints allowed within **24 inches** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

C. Remove and replace metal wall panels where tests and inspections indicate that they do not

comply with specified requirements.

D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.13

SECTION 077129
MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flanged bellows-type roof expansion joints.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wooden curbs or cants for mounting roof expansion joints.
2. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-fabricated sheet metal expansion-joint systems, flashing, and other sheet metal items.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Flanged bellows-type roof expansion joints.

B. Shop Drawings: For roof expansion joints.

1. Include plans, elevations, sections, and attachment details.
2. Include details of splices, intersections, transitions, fittings, method of field assembly, and location and size of each field splice.
3. Provide isometric drawings of intersections, terminations, changes in joint direction or planes, and transition to other expansion joint systems depicting how components interconnect with each other and adjacent construction to allow movement and achieve waterproof continuity.

C. Samples: For each exposed product and for each color specified, **6 inches** in size.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each fire-barrier provided as part of a roof-expansion-joint assembly, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer of roofing membrane.

1.6 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof expansion joints that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint seals, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 FLANGED BELLOWS-TYPE ROOF EXPANSION JOINTS

A. Flanged Bellows-Type Roof Expansion Joint: Factory-fabricated, continuous, waterproof, joint cover consisting of exposed membrane bellows laminated to flexible, closed-cell support foam, and secured along each edge to **3- to 4-inch-** wide metal flange.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville, Expand-O-Flash Expansion Joint Cover or comparable product by one of the following:

a. inpro Corporation

2. Source Limitations: Obtain flanged bellows-type roof expansion joints approved by roofing manufacturer and that are part of roofing membrane warranty.
3. Joint Movement Capability: Plus and minus 25 percent of joint size.

4. Bellows: EPDM flexible membrane, nominal 60 mils thick.
5. Flanges: Galvanized steel, 0.022 inch thick.
6. Configuration: Flat to fit cants as indicated on Drawings.
7. Corner, Intersection, and Transition Units: Provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints.
8. Cover Membrane: EPDM flexible membrane, factory laminated to bellows and covering entire joint assembly and curbs.

    a. Color: Black.

9. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.
10. Secondary Seal: Continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary bellows assembly.

    a. Thermal Insulation: Fill space above secondary seal with manufacturer's standard, factory-installed mineral-fiber insulation; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84.

11. Fire Barrier: Manufacturer's standard fire barrier for fire-resistance-rated expansion joint system.

B. Materials:

1. Galvanized-Steel Sheet: ASTM A653/A653M, hot-dip zinc-coating designation **G90**.
2. EPDM Membrane: ASTM D4637/D4637M, type standard with manufacturer for application.
3. Aluminum: **ASTM B209** for sheet and plate, **ASTM B221** for extrusions; alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

    a. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious or preservative-treated wood materials.
    b. Mill Finish: As manufactured.
    c. Class II, Clear Anodic Finish: Architectural Class II, clear coating 0.010 mm or thicker, complying with AAMA 611.
    d. Class I, Clear Anodic Finish: Architectural Class I, clear coating 0.018 mm or thicker, complying with AAMA 611.
    e. Class I, Color Anodic Finish: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker, complying with AAMA 611.
    f. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

        1) Two-Coat Fluoropolymer: System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
        2) Three-Coat Fluoropolymer: System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.

    g. Aluminum Finish Color: As selected by Architect from manufacturer's full range.

4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304; finish ASTM A480/A480M No. 2B.

5. Foam: Polyurethane foam impregnated with fire-retardant acrylic polymers.
6. Silicone Facings: ASTM C920, ultra-low-modulus, one-part, neutral-cure silicone sealant, UV stabilized, and that does not propagate flame.

2.3 MISCELLANEOUS MATERIALS

A. Adhesives: As recommended by roof-expansion-joint manufacturer.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.

1. Exposed Fasteners: Gasketed. Use screws with hex washer heads matching color of material being fastened.

C. Mineral-Fiber Blanket: ASTM C665.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joint openings, substrates, and expansion-control joint systems that interface with roof expansion joints, for suitable conditions where roof expansion joints will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for handling and installing roof expansion joints.

1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
2. Install roof expansion joints true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
3. Provide for linear thermal expansion of roof-expansion-joint materials.
4. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.
5. Provide uniform, neat seams.
6. Install roof expansion joints to fit substrates and to result in watertight performance.

B. Directional Changes: Install factory-fabricated units at directional changes to provide continuous, uninterrupted, and watertight joints.

C. Transitions to Other Expansion-Control Joint Assemblies: Coordinate installation of roof expansion joints with other exterior expansion-control joint assemblies specified in Section 079513.16 "Exterior Expansion Joint Cover Assemblies" to result in watertight performance. Install factory-fabricated units at transitions between roof expansion joints and exterior expansion-control joint systems.

D. Splices: Splice roof expansion joints to provide continuous, uninterrupted, and waterproof joints.

1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.

E. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

END OF SECTION 077129

SECTION 077253
SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rail-type, seam-mounted snow guards.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Rail-type, seam-mounted snow guards.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

1. Include details of rail-type snow guards.

C. Samples:

1. Rail-Type Snow Guards: Bracket, **12-inch-** long rail, and installation hardware.

a. For units with factory-applied finishes, submit manufacturer's standard color selections.

D. Delegated Design Submittals: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include calculation of number and location of snow guards.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit adhesive-mounted snow guards to be installed, and adhesive cured, according to adhesive manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design snow guards, including attachment to roofing material and roof deck, as applicable for attachment method, based on the following:

1. Roof snow load.
2. Snow drifting
3. Roof slope.
4. Roof type.
5. Roof dimensions.
6. Roofing substrate type and thickness.
7. Snow guard type.
8. Snow guard fastening method and strength.
9. Snow guard spacing.
10. Coefficient of Friction Between Snow and Roof Surface: 0.
11. Factor of Safety: 2.

B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Structural Performance: Snow guards to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Snow Loads: As indicated on Drawings.

2.2 RAIL-TYPE SNOW GUARDS

A. Rail-Type, Seam-Mounted Snow Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Alpine SnowGuards
b. S-5! Metal Roof Innovations, Ltd.: DualGard
c. S-5! Metal Roof Innovations, Ltd.: SnoRail/SnoFence
d. TRA Snow and Sun, Inc.

2. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with two rails,two rails with integral track to accept color-matching inserts of material and finish used for metal roof.
3. Brackets and Baseplate: ASTM B209 aluminum; clear anodized.
4. Bars: ASTM B221 aluminum, clear anodized.

a. Profile: Round,with integral track to accept color-matching inserts of material and finish used for metal roof.

5. Seam Clamps: **ASTM B221** aluminum extrusion or ASTM B85/B85M aluminum casting

with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates for bonding snow guards.

B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

A. Install snow guards according to manufacturer's written instructions.

1. Space rows as indicated on Drawings.

B. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
2. Rail-Type, Seam-Mounted Snow Guards:

a. Install brackets to vertical ribs in straight rows.
b. Secure with stainless steel set screws, incorporating round nonpenetrating point, on same side of standing seam.
c. Torque set screw in accordance with manufacturer's written instructions.
d. Install cross members to brackets.

END OF SECTION 077253

SECTION 079200
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Joint sealants.
2. Joint-sealant backing materials.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in **1/2-inch-** wide joints formed between two **6-inch-** long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

B. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

D. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.

B. Installer's special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.7 MOCKUPS

A. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.

    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

2. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants

that fail adhesively, retest until satisfactory adhesion is obtained.

3. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
4. Conduct field tests for each kind of sealant and joint substrate.
5. Notify Architect seven days in advance of dates and times when test joints will be erected.
6. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.9 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.10 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, non-sag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Sika Corporation - Building Components
c. Tremco Incorporated
d. Substitutions: Under provisions of Section 012500

B. Silicone, S, NS, 25, T, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pecora Corporation
b. Sika Corporation - Building Components
c. Substitutions: Under provisions of Section 012500

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 100/50, T, NT: Single-component, non-sag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Sika Corporation

b. Tremco Incorporated
c. Substitutions: Under provisions of Section 012500

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation
b. Tremco Incorporated
c. BASF Building Systems
d. Substitutions: Under provisions of Section 012500

2.6 MISCELLANEOUS MATERIALS

A. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

B. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous

joint substrates include the following:

a. Concrete.
b. Masonry.
c. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.
b. Glass.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form

smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Prepare test and inspection reports.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 079513.16
EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior expansion joint covers.
2. Silicone bellows.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

1. Exterior expansion joint covers.
2. Silicone bellows.

B. Shop Drawings: For each expansion joint cover assembly.

1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

C. Samples: For each exposed expansion joint cover assembly and for each color and texture specified, full width by **6 inches** long in size.

D. Samples for Initial Selection: For each type of exposed finish.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

E. Samples for Verification: For each type of expansion joint cover assembly, full width by **6 inches** long in size.

F. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

1. Manufacturer and model number for each expansion joint cover assembly.
2. Expansion joint cover assembly location cross-referenced to Drawings.
3. Nominal, minimum, and maximum joint width.
4. Movement direction.
5. Materials, colors, and finishes.
6. Product options.
7. Fire-resistance ratings.

1.3 MOCKUPS

A. Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of typical expansion joint cover assembly as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Expansion Joint Design Criteria 1/A13.2 and 2/A13.2:

1. Type of Movement: Wind sway.

a. Nominal Joint Width: As indicated on Drawings.
b. Minimum Joint Width: As indicated on Drawings.
c. Maximum Joint Width: As indicated on Drawings.

2.3 MATERIALS

A. Aluminum: **ASTM B221**, Alloy 6063-T5 for extrusions; **ASTM B209**, Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304 for plates, sheet, and strips.

C. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

2.4 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.

1. Provide where indicated on Drawings.

B. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Install frames in continuous contact with adjacent surfaces.
   a. Shimming is not permitted.

5. Locate anchors at interval recommended by manufacturer, but not less than **3 inches**

from each end and not more than **24 inches** o.c.

C. Elastomeric Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Preformed Foam Joint Seals: Install in compliance with manufacturer's written instructions. Install with minimum number of end joints.

1. Install each length of seal immediately after removing protective wrapping.
2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

E. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

F. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

G. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

H. Moisture Barrier Drainage: If indicated, provide drainage fitting and connect to drains.

3.4 CONNECTIONS

A. Transition to Roof Expansion Joint Covers: Coordinate installation of exterior wall and soffit expansion joint covers with roof expansion joint covers specified in Section 077129 "Manufactured Roof Expansion Joints." Install factory-fabricated units at transition between exterior walls and soffits and roof expansion joint cover assemblies.

3.5 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections.

END OF SECTION 079513.16

SECTION 082220
FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fiberglass reinforced plastic doors
2. Fiberglass reinforced plastic frames

1.2 PREINSTALLATION MEETINGS

A. Within 30 days of Contract Award, the Contracting Officer will:

1. Schedule a Pre-Installation meeting. For that meeting, submit the following Shop Drawings for review and approval:

a. Doors
b. Frames
c. Door Hardware Components and Accessories
d. Weather-stripping
e. Smoke Seals

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1. Doors
2. Calculations
3. Frames
4. Door Hardware Components and Accessories
5. Weather-stripping
6. Thresholds

B. Shop Drawings:

1. Doors
2. Frames
3. Door Hardware Components and Accessories
4. Weather-stripping

C. Samples for Initial Selection:

1. Include Samples of door and frame (Minimum 6 inch by 6 inch).
2. Submit two sets of color chips representing specified colors and finishes.

3. Submit samples of each type, consisting of FRP door corner construction,
4. Where color or texture variations are anticipated, such as anodized finishes, include two or more units in each set of samples indicating extreme limits of variations.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver FRP doors, frames, components and accessories in manufacturer's original unopened packaging. Mark and remove damaged materials from the project site. Where materials are covered by a referenced specification, label the package with the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

B. Protect materials against moisture absorption and contamination or other damage.

C. Store all materials on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer.

D. Do not store materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover materials stored outdoors, with waterproof canvas protective covering. Tie covering securely to pallets to ensure complete weatherproofing is met. Provide sufficient ventilation to prevent condensation. Do not use polyethylene sheet as a covering.

E. Do not store materials in contact with other materials that might cause staining, denting, or other surface damage.

F. Prevent damage to corners, edges and ends of materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials.

1.6 FIELD CONDITIONS

A. Take Field measurements prior to the preparation of drawings and fabrication

1.7 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Submit sample material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard manufacturer warranty as required to comply with the specified requirements.

B. Furnish the manufacturer's 10 year no dollar limit for materials and installation, workmanship, and deterioration of factory-applied finishes within specified warranty period. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the work.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Provide door and frame components including, but not limited to, astragals, cores, faces, stiles, rails, heads, jambs, and internal reinforcement, which are FRP structural shapes manufactured by the pultrusion process. Ensure all structural shapes are composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements in accordance with ASCE 7-16, [ICC IBC] and dimensions specified.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Weiland, Inc.
    b. Ceco
    c. Corrim
    d. Substitutions: Under provisions of Section 012500

B. Ensure fiberglass reinforcements are a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

C. Verify resins are of isophthalic polyester with chemical formulation necessary for corrosion resistance, strength and other physical properties as required.

2.2 FINISH SURFACES

A. Ensure all finished surfaces of FRP items and fabrications are smooth, resin-rich, free of voids and without dry spots, cracks, and un-reinforced areas. Completely cover all glass fibers with resin to protect against their exposure due to wear or weathering. All stiles, rails, heads, jambs, and internal reinforcement are to be integrally pigmented.

B. Fiberglass door exterior to be built starting with 25 mils of premium gel coat molded into a continuous layer of fiberglass that completely surrounds all sides of the interior structure of the door. The entire door is to be molded at once for truly seamless fiberglass. Fiberglass thickness (not including gel coat) to be at least 3/16” on the face of the door and 3/8” on the edge of the doors.

C. Color: Integral color to be selected from Manufacturer’s standard colors.

2.3 ULTRAVIOLET PROTECTION

A. Provide documentation that all pultruded structural shapes are further protected from ultraviolet (UV) attack with:

1. Integral UV inhibitors within the resin
2. Synthetic surfacing veil to help produce a resin rich surface
3. UV resistant coating for outdoor exposures.

2.4 FLAME SPREAD RATING

A. All FRP products to have a flame spread rating of 25 or less as per ASTM E84Tunnel Test.

2.5 STRUCTURAL PROPERTIES

A. Meet minimum longitudinal structural properties with structural shapes in the door and frame system as follows:

Tensile Strength	ASTM D638	30,000 psi
Compressive Strength	ASTM D695	30,000 psi
Flexural Strength	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	1,600,000 psi
Short Beam Shear	ASTM D2344/D2344M	4,500 psi
Impact, Notched	ASTM D256	25 ft-lb/in
Thermal Expansion	ASTM D696	.000008 in/in/F

2.6 FRP DOOR

A. Provide and install a seamless press-molded constructed FRP door. Laminate FRP face sheets to be applied while wet and uncured to an internal door stile and rail subframe/core assembly which is pressure molded under heat. Integrally fuse the composite door panel over the entire surface area, do not adhesive-bond at the perimeter stile and rail.

B. Provide door stiles and rails which are high-modulus pultruded FRP square or rectangular tube subframe. Miter and join tubes internally at the corners with solid polymer blocks to yield a one piece unit. Provide a mid-rail tube across the width of the door at lockset height and additional horizontal rails where specified. Chemically weld all connections. No mechanical fastening at the tube joints is permitted.

C. Provide a triangular shaped .375 cm 3/8 inch phenolic resin impregnated kraft paper honeycomb cell core for maximum rigidity and compressive strength. Use of polyurethane foam or balsa wood cores are not permitted

D. Provide internal reinforcement composed of high-modulus pultruded tubular FRP or high-density polymer compression blocks at all hardware and corner locations. No aluminum, steel, or wood blocking for reinforcement is permitted. A minimum pull-out force strength of 900 pounds per screw is required for all hinge locations.

E. Door faces are to utilize a chemical resistant thermosetting polyester resin with fiberglass

reinforcing layers. Provide structural reinforcement which is knitted multi-layer material with layers of unidirectional fiberglass orientated in both vertical and horizontal directions for high stiffness, impact and warp resistance. Furnish door faces as indicated by the door elevation drawings.

F. Ensure the exposed finish of the FRP door faces are to be an ultra-violet light stabilized marine grade Neopentyl Glychol (NPG)-isophthalic polyester gelcoat integrally molded to a 25/30 mil wet thickness.

2.7 FRP FRAME

A. Provide FRP Door Frame utilizing a high-modulus pultruded structural FRP shape. Fabricate pultruded frame with a wall thickness of not less than 5 mm 3/16 inch. Frames are to be one piece factory constructed with molded stop. Jambs and header to utilize miter corner connections chemically welded with FRP material ground for a visibly smooth frame face. Post and beam or mechanical fastened corners and joints are not acceptable. Provide sizes and shapes as detailed on the approved drawings

B. Provide hardware reinforcement connections utilizing a chemical weld with FRP material at required locations. A minimum pull-out force strength of 1,100 lbs per screw is required for all hardware locations.

2.8 FRAME ANCHORS

A. Provide anchorage devices and fasteners where necessary for fastening fabricated FRP door frame to the adjacent construction-in-place as recommended by the FRP frame manufacturer.

2.9 JAMB ANCHORS

A. Provide anchors of the material, type, number, and spacing as required by the FRP frame manufacturer.

2.10 HARDWARE PREPARATION

A. Provide hardware reinforcing as specified. Prepare doors and frames for hardware in accordance with the applicable requirements of the FRP door and frame manufacturer. For additional requirements refer to ANSI/BHMA A156.115.

2.11 PERFORMANCE REQUIREMENTS

A. Structural

1. Design doors and frames to withstand the specified design wind load acting normal to the plane of the entrance wall either inward or outward, in accordance with ASCE 7-16.

B. Air Infiltration

1. When tested in accordance with ASTM E283, air infiltration cannot to exceed 2.63 by 10-5 cms per square meter 0.06 cubic feet per minute per square foot of fixed area at a test

pressure of 0.30 kPa 6.24 pounds per square foot 80 kilometers 50 mile per hour wind.

C. Water Penetration

1. When tested in accordance with ASTM E331, no water penetration is allowed, at a pressure of 0.38 kPa 8 pounds per square foot of fixed area.

D. Provisions for Thermal Movement

1. Design doors and frames to provide for expansion and contraction of the component parts caused by an ambient temperature range of minus 17.8 to 37.8 degrees C 0 to 100 degrees F causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conform all work to the requirements of 29 CFR 1910, 29 CFR 1926,and NFPA 241.

3.2 FRP FRAME

A. Set FRP door frame plumb and true, aligned, and secured with the adjacent construction-in-place, in conformance with ASTM E2112. Anchor frame as specified and in accordance with the FRP door manufacturer's requirements.

B. Installation Tolerances

1. Squareness: Plus or minus 1.6 mm 1/16 inch, measure at the door rabbet on a line 90 degrees from the jamb perpendicular to the frame head.
2. Alignment: Plus or minus 1.6 mm 1/16 inch, measure at the jamb on a horizontal line parallel to the wall plane.
3. Twist: Plus or minus 1.6 mm 1/16 inch, measure at the opposite face corners of the jambs on parallel lines, and perpendicular to the wall plane.
4. Plumb and True: Plus or minus 1.6 mm 1/16 inch, measure at the jambs to the floor.

3.3 FRP DOOR

A. Fit and hang door in accordance with clearances specified below:

B. Clearance Tolerances

1. Jambs and Head: Plus 3 mm 1/8 inch or minus 1.6 mm 1/16 inch.
2. Pairs of Doors: Plus 3 mm 1/8 inch or minus 1.6 mm 1/16 inch.
3. Bottom of Door and Top of Threshold: Maximum 9.5 mm 3/8 inch.
4. Bottom of Door and Top of finish floor (No Threshold: Maximum 19 mm 3/4 inch.

3.4 ADJUSTING AND CLEANING

A. Check and re-adjust all operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including all FRP that is warped, bowed, or otherwise unacceptable to the Contracting Officer.

3.5 PROTECTION

A. Protect doors and frames from damage. Repair damaged doors and frames prior to final completion and acceptance of the project or replace with new, as directed by the Contracting Officer. Thoroughly clean all surfaces of the door and frame prior to final completion and acceptance of the project.

3.6 CLOSEOUT ACTIVITIES

A. Warranty: Submit the approved Warranty made out to the Government, to the Contracting Officer no later than 10 days prior to final inspection.

END OF SECTION 082220

SECTION 083613
SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sectional-door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed finish and for each color and texture required on the following components, in manufacturer's standard sizes:

1. Glazing.
2. Metal for door sections.
3. Hardware.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For manufacturer's warranty and finish warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sectional doors to include in maintenance manuals.

B. Manufacturer's warranty.

C. Finish warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

B. Regulatory Requirements: Comply with provisions in the U.S. Department of Justice's "2010 ADA Standards for Accessible Design", U.S. Department of Transportation's "ADA Standards for Transportation Facilities", the United States Access Board's "Architectural Barriers Act (ABA) Standards",ICC A117.1 applicable to sectional doors.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Failure of components or operators before reaching required number of operation cycles.
c. Faulty operation of hardware.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
e. Delamination of exterior or interior facing materials.

2. Warranty Period: Five years from date of Substantial Completion.

B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings.
2. Testing: In accordance with ASTM E330/E330M or DASMA 108 for garage doors and complying with DASMA 108 acceptance criteria.
3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.

a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.

C. Windborne-Debris Impact Resistance: Provide sectional doors complying with the following requirements:

1. Glazed Openings: Pass ASTM E1886 Large Missile Test and cyclic-pressure tests in accordance with ASTM E1996 for basic protection and Wind Zone applicable to basic design wind speed indicated on Drawings.
2. Garage-Door Glazed Openings: Pass DASMA 115.

2.3 SECTIONAL-DOOR ASSEMBLY

A. Sectional Door: Provide steel sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Clopay Building Products
b. Haas Door; a Nofziger Company
c. Overhead Door Corporation
d. Raynor Garage Doors
e. Substitutions: Under provisions of Section 012500

B. Operation Cycles: Door components and operators capable of operating for not less than 50,000 operation cycles. One operation cycle is complete when door is opened from closed

position to the open position and returned to closed position.

C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. when tested in accordance with ASTM E283 or DASMA 105.

D. U-Value: 0.052 Btu/sq. ft. x h x deg F.

E. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G60 zinc coating.

1. Door-Section Thickness: 1-3/4 inches.
2. Section Faces:

    a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
    b. Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.

        1) Steel Sheet Thickness: 0.022-inch nominal coated thickness.
        2) Surface: Manufacturer's standard, wood-grain embossed.

    c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:

        1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of 0.022 inch.

3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch nominal coated thickness and welded to door section.
4. Intermediate Stiles: Provide intermediate stiles formed from not less than 0.040-inch-thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.
5. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.

    a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
    b. Hardware Locations: Provide reinforcement for hardware attachment.

6. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free insulation of type indicated below:

    a. Board Insulation: Polystyrene, or, polyurethane, secured to exterior face sheet.
    b. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
    c. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.

F. Track: Manufacturer's standard, galvanized-steel, high-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.

1. Material: Galvanized steel, ASTM A653/A653M, minimum **G60** zinc coating.
2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.
3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced **2 inches** apart for door-drop safety device.

    a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide continuous angle,intermittent jamb brackets attached to track and wall.
    b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

G. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top, and, jambs of door. Provide combination bottom weatherseal and sensor edge for bottom seal.

H. Windows: Manufacturer's standard window units of shape and size and in locations indicated on Drawings. Set glazing in vinyl, rubber, or neoprene glazing channel. Provide removable stops of same material as door-section frames. Provide the following glazing:

1. Clear Polycarbonate Plastic: 3 mm thick, transparent, fire-retardant, UV-resistant, polycarbonate sheet manufactured by extrusion process.

I. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.

1. Hinges: Heavy-duty, galvanized-steel hinges of not less than **0.079-inch** nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.

    a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
    b. Provide double-end hinges where required for doors more than **16 ft.** wide unless otherwise recommended by door manufacturer in writing.

2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.

    a. Roller-Tire Material: Case-hardened steel.

3. Push/Pull Handles: Equip each door with galvanized-steel lifting handles on each side of door, finished to match door.

J. Locking Device:

1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
2. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating

handle, cam plate, and adjustable locking bars to engage through slots in tracks.

a. Lock Cylinders: Cylinders complying with Section 087100 "Door Hardware" requirements.

3. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

K. Counterbalance Mechanism:

1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.

a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
b. Provide one additional midpoint bracket for shafts up to **16 ft.** long and two additional brackets at one-third points to support shafts more than **16 ft.** long unless closer spacing is recommended in writing by door manufacturer.

3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.
4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

L. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
4. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
5. Operator Type: Trolley.
6. Motor: Reversible-type with controller (disconnect switch) for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.

a. Motor Size: As required to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
b. Electrical Characteristics:

1) Phase: Single phase.

2) Volts: Match Field Maintenance V.

7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

   a. Monitored Entrapment Protection: Photoelectric sensor designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
   b. Unmonitored Entrapment Protection: Pneumatic sensor edge, black, located within weatherseal mounted to bottom bar.

9. Control Station: Surface mounted, three-position (open, close, and stop) control.

   a. Operation: Push button.
   b. Interior-Mounted Unit: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
   c. Exterior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof type, NEMA ICS 6, Type 4 enclosure.
   d. Features: Provide the following:

      1) Vehicle detection operation.
      2) Radio-control operation.
      3) Card-reader control.
      4) Photocell operation.
      5) Door-timer operation.
      6) Explosion- and dust-ignition-proof control wiring.
      7) Audible and visual signals that comply with regulatory requirements for accessibility.

10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf.
11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

M. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

1. Factory Prime Steel Finish: Compatible with field-applied finish and in manufacturer's standard color. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
2. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

   a. Aluminum Finish: Comply with AAMA 2603 requirements for pigmented organic coatings applied to aluminum extrusions and panels.

b. Color and Gloss: As selected by Architect from manufacturer's full range.

3. Anodized Aluminum Finish: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
b. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1) Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than **24 inches** apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install automatic garage doors openers in accordance with UL 325.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084523
FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panels as follows:

1. Wall assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.

B. Shop Drawings: For panel assemblies.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.

C. Samples: In manufacturer's standard size.

1. For each type of fiberglass-sandwich panel.
2. For each type of exposed finish for framing members.

D. Fabrication Samples: Of each framing system intersection and adjacent panels, made from **12-inch** lengths of full-size framing members and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Fiberglass-sandwich panels.
5. Flashing and drainage.

E. Delegated Design Submittals: For panel assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer, manufacturer.

B. Product Test Reports: For each fiberglass-sandwich-panel assembly, for tests performed by a qualified testing agency.

C. Evaluation Reports: For fiberglass-sandwich-panel assemblies from ICC-ES.

D. Field quality-control reports.

E. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICC-ES AC04 or ICC-ES AC177.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Water leakage.

2. Warranty Period: Five years from date of Substantial Completion.

B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace fiberglass-sandwich panels that exhibit defects in materials or workmanship within specified warranty period.

1. Defects include, but are not limited to, the following:

a. Fiberbloom.
b. Delamination of coating, if any, from exterior face sheet.
c. Color change exceeding requirements.
d. Delamination of panel face sheets from panel cores.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design fiberglass-sandwich-panel assemblies.

B. Structural Loads: As indicated on Drawings.

C. Deflection Limits:

1. Vertical Panel Assemblies: Limited to 1/60 of clear span for each assembly component.

D. Structural-Test Performance: Provide panel assemblies tested in accordance with ASTM E330, as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

F. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

G. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:

1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas to have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas to have a SHGC of no greater than 0.6 as determined in accordance with NFRC 200.
3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined in accordance with ASTM E283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..

2.2 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kalwall Corporation: Facades or comparable product by one of the following:

a. Kalwall Corporation
b. Major Industries, Inc.: Guardian 275 Skylights and Canopies
c. Major Industries, Inc.: LightBasic Wall Systems
d. Substitutions: Under provisions of Section 012500

2.3 FIBERGLASS-SANDWICH PANELS

A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.

1. Core Insulation: Fill panel cores with aerogel.

B. Panel Thickness: 2-3/4 inches.

C. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of **7/16 inch**.

1. Extruded Aluminum: **ASTM B221**, in alloy and temper recommended in writing by manufacturer.
2. I-Beam Construction: Thermally broken, extruded aluminum.
3. Grid Pattern: As indicated on Drawings.

D. Exterior Face Sheet:

1. Thickness: 0.070 inch.
2. Color: Crystal.
3. Protective Weathering Surface: Manufacturer's standard.

E. Interior Face Sheet:

1. Thickness: 0.045 inch.
2. Color: Crystal.

F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.

G. Panel Strength:

1. Maximum Panel Deflection: **3-1/2 inches** when a **4-by-12-foot** panel is tested in accordance with ASTM E72 at **34 lbf/sq. ft.**, with a maximum **0.090-inch** set deflection after five minutes.
2. Panel Support Strength: Capable of supporting, without failure, a **300-lbf** concentrated load when applied to a **3-inch-** diameter disk in accordance with ASTM E661.

H. Panel Performance:

1. Self-Ignition Temperature: **650 deg F** or more in accordance with ASTM D1929.
2. Smoke-Developed Index: 450 or less in accordance with ASTM E84, or 75 or less in accordance with ASTM D2843.
3. Combustibility Classification: Class CC1 based on testing in accordance with ASTM D635.
4. Interior Finish Classification: Class B based on testing in accordance with ASTM E84.
5. Color Change: Not more than 3.0 units Delta E, when measured in accordance with ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.

    a. Outdoor Weathering Conditions: Sixty months in southern Florida.

6. Impact Resistance: No fracture or tear at impact of 70 ft. x lbf by a **3-1/4-inch-** diameter, **5-lb** freefalling ball in accordance with UL 972 test procedure.
7. Haze Factor: Greater than 90 percent when tested in accordance with ASTM D1003.

2.4 ALUMINUM FRAMING SYSTEMS

A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken, extruded aluminum.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: **ASTM B209**.
2. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B221**.
3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
4. Structural Profiles: ASTM B308/B308M.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

1. At closures, retaining caps, or battens, use ASTM A193/A193M, 300 series stainless steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M orASTM A153/A153Mrequirements.

F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.

G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

H. Exposed Flashing and Closures: Aluminum sheet not less than 0.050 inch thick, finished to match framing.

I. Framing Gaskets: Manufacturer's standard.

J. Frame-System Sealants: As recommended in writing by manufacturer.

K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for **15-mil** dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 FABRICATION

A. Frame System Fabrication:

1. Fabricate components that, when assembled, have the following characteristics:

a. Profiles that are sharp, straight, and free of defects or deformations.
b. Accurately fitted joints with ends coped or mitered.
c. Internal guttering systems or other means to drain water passing through joints, and moisture migrating within assembly to exterior.

2. Fabricate sill closures with weep holes and for installation as continuous component.
3. Reinforce components as required to receive fastener threads.

B. Panel Fabrication: Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.

a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every **40 sq. ft.** of panel and limited in diameter to **3/64 inch**.

2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
3. Fabricate panel to allow condensation within panel to escape.
4. Reinforce panel corners.

2.6 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.

5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install components plumb and true in alignment with established lines and elevations.

D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters. Install components to drain water passing through joints and moisture migrating within assembly to exterior.

E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to **1/32 inch** where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than **3 inches**; otherwise, limit offset to **1/8 inch**.
2. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet**, but no greater than **1/2 inch** over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies to be tested in accordance with AAMA 501.2 and to not show evidence of water penetration.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

END OF SECTION 084523

SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Requirements:

1.2 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

B. Keying Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:

a. Flow of traffic and degree of security required.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples for Initial Selection: For each type of exposed finish.

D. Samples for Verification: For each type of exposed product, in each finish specified.

1. Sample Size: Full-size units or minimum **2-by-4-inch** Samples for sheet and **4-inch** long Samples for other products.

a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

2. Tag Samples with full product description to coordinate Samples with door hardware schedule.

E. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.

e. Fastenings and other installation information.
f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
g. Mounting locations for door hardware.
h. List of related door devices specified in other Sections for each door and frame.

F. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of electrified door hardware.

1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware, and, keying schedule.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to

Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design".

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than **5 lbf**.
2. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: **5 lbf** applied perpendicular to door.
b. Sliding or Folding Doors: **5 lbf** applied parallel to door at latch.

c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than **1/2 inch** high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc
b. Baldwin; part of the Spectrum Brands Hardware and Home Improvement Group (HHI)
c. Bommer Industries, Inc
d. Hager Companies
e. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
f. PBB, Inc
g. STANLEY; dormakaba USA, Inc.

2.4 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: BHMA A156.25; Grade 1; motor or solenoid driven; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BEST Access Solutions, Inc.; dormakaba USA Inc.
b. SARGENT Manufacturing Company; ASSA ABLOY
c. Yale Security Inc; ASSA ABLOY
d. Schlage Commercial Lock Division; an Allegion Company (formerly Ingersol Rand) (SCH)

2. Type: Mortise latchbolt.

2.5 SELF-CONTAINED ELECTRONIC LOCKS

A. Self-Contained Electronic Locks: BHMA A156.25, mortise; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the

following:

a. BEST Access Solutions, Inc.; dormakaba USA Inc.
b. SARGENT Manufacturing Company; ASSA ABLOY
c. Yale Security Inc; ASSA ABLOY
d. Schlage Commercial Lock Division; an Allegion Company (formerly Ingersol Rand) (SCH)

2.6 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum **3/4-inch** throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adams Rite Manufacturing Company, an ASSA ABLOY Group company
b. Allegion plc
c. Burns Manufacturing Incorporated
d. Door Controls International
e. Hiawatha, Inc; a division of the Activar Construction Products Group
f. Trimco

2.7 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Schlage or comparable product by one of the following:

a. Similar products of equal quality are acceptable

2. All door hardware and cylinders must accept a small-format interchangeable core.
3. Cores are BEST by Dorma Kaba and are provided by GFIAA. Keying is by GFIAA.

B. High-Security Lock Cylinders: BHMA A156.30; Grade 1 permanent cores that are removable; face finished to match lockset.

1. Type: M, mechanical.
2. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
3. All door hardware and cylinders must accept a small-format interchangeable core.
4. Cores are BEST by Dorma Kaba and are provided by GFIAA. Keying is by GFIAA.

C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.8 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix.

Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. Existing System:

    a. Master key or grand master key locks to Owner's existing system.
    b. Re-key Owner's existing master key system into new keying system.

2.9 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Burns Manufacturing Incorporated
    b. Don-Jo Mfg., Inc
    c. Forms+Surfaces
    d. Hager Companies
    e. Hiawatha, Inc; a division of the Activar Construction Products Group
    f. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
    g. IVES
    h. IVES Hardware; an Ingersoll-Rand company

2.10 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Arrow USA; an ASSA ABLOY Group company
    b. Corbin Russwin, Inc.; an ASSA ABLOY Group company
    c. Hager Companies: Series 5100
    d. SARGENT Manufacturing Company; ASSA ABLOY
    e. Yale Security Inc; ASSA ABLOY

2.11 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Hager Companies

b. M-D Building Products, Inc
c. National Guard Products, Inc
d. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
e. Reese Enterprises, Inc
f. Zero International; Allegion plc

B. Maximum Air Leakage: When tested in accordance with ASTM E283 with tested pressure differential of **0.3-inch wg**, as follows:

1. Smoke-Rated Gasketing: **0.3 cfm/sq. ft.** of door opening.
2. Gasketing on Single Doors: **0.3 cfm/sq. ft.** of door opening.
3. Gasketing on Double Doors: **0.50 cfm per ft.** of door opening.

2.12 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies
b. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
c. Reese Enterprises, Inc
d. Rixson Specialty Door Controls; ASSA ABLOY
e. Zero International; Allegion plc

2.13 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from **0.050-inch-** thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc
b. Hager Companies
c. Hiawatha, Inc; a division of the Activar Construction Products Group
d. inpro Corporation

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and

hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
2. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every **30 inches** of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every **30 inches** of door height greater than **90 inches**.

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

F. Key Control System:

1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.
3. Key Control System Software: Set up multiple-index system based on final keying schedule.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in equipment room. Verify location with Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.8 DOOR HARDWARE SCHEDULE

A. Hardware Set 1: Each door to have the following:

1. Hardware Group No. 01: For use on Door #(s) M135A, M135B, M135E, M135J, and M135L:

(3 EA) HINGE, MODEL: 5BB1 4.5 X 4.5, FINISH: 652, MFR: IVE
(1 EA) STOREROOM LOCK, MODEL: L9080L 03A, FINISH: 626, MFR: SCH
(1 EA) MORTISE CYLINDER, MFR: SCH
(1 EA) CORE, MODEL: BY OWNER, MFR: BEST, DORMA KABA
(1 EA) SURFACE CLOSER, MODEL: 4040XP, FINISH: 689, MFR: LCN
(1 EA) KICK PLATE, MODEL: 8400 10" X DOOR WIDTH LDW B-CS, FINISH: 630, MFR: IVE
(1 EA) GASKETING, MODEL: 488S, FINISH: BK, MFR: ZER

B. Hardware Set 2: Each door to have the following:

1. Hardware Group No. 02: For use on Door #(s) M137 and M138

(3 EA) HINGE, MODEL: 5BB1 4.5 X 4.5, FINISH: 652, MFR: IVE
(1 EA) POWER TRANSFER, MODEL: EPT10 CON, FINISH: 689, MFR: VON
(1 EA) EU MORTISE LOCK, MODEL: L9092LEU 03A RX CON 12/24 VDC, FINISH: 626, MFR: SCH
1 EA) MORTISE CYLINDER, MFR: SCH
(1 EA) CORE, MODEL: BY OWNER, MFR: BEST, DORMA KABA
(1 EA) SURFACE CLOSER, MODEL: 4040XP, FINISH: 689, MFR: LCN
(1 EA) KICK PLATE, MODEL: 8400 10" X DOOR WIDTH" LDW B-CS, FINISH: 630, MFR: IVE
(1 EA) GASKETING, MODEL: 488S, FINISH: BK, MFR: ZER

OPERATION:
1. DOOR NORMALLY LOCKED.
2. ACCESS BY CARD READER/ACCESS CONTROL OR KEY OVERRIDE.
3. FREE EGRESS AT ALL TIMES.
4. ON LOSS OF POWER, DOOR FAILS SECURE

END OF SECTION 087100

SECTION 099123
INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Water-based finish coatings.
3. Solvent-based finish coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include preparation requirements and application instructions.

B. Samples: For each type of topcoat product.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, **8 inches** square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F**.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.4 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F**.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than **5**

deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 PRIMERS

A. Alkali-Resistant, Water-Based Primer: Water-based primer formulated for use on alkaline surfaces, such as plaster, vertical concrete, and masonry.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Benjamin Moore & Co., or comparable product by one of the following:

a. Behr Paint Company; Behr Process Corporation
b. Benjamin Moore & Co.
c. PPG Paints; PPG Industries, Inc.
d. Sherwin-Williams Company (The)
e. Substitutions: Under provisions of Section 012500

B. Alkyd Quick-Dry Primer for Metal: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, interior steel surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Benjamin Moore & Co.
b. PPG Paints; PPG Industries, Inc.
c. Sherwin-Williams Company (The)
d. Substitutions: Under provisions of Section 012500

2.2 SOLVENT-BASED FINISH COATS

A. Interior, Alkyd, Semigloss: Pigmented, solvent-based alkyd paint for use on primed/sealed interior plaster, gypsum, wood, and metal walls primarily in residential and moderate traffic commercial environments.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Benjamin Moore & Co.: Unknown Product Name
b. PPG Paints; PPG Industries, Inc.
c. Sherwin-Williams Company (The)
d. Substitutions: Under provisions of Section 012500
e. Insert Manufacturers Name

2. Gloss Level: Manufacturer's standard semigloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2.
2. SSPC-SP 3.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

3.3 INSTALLATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

    a. Equipment, including panelboards.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:

a. Prime Coat: Alkali-resistant, water-based primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior latex paint, .

2. High-Performance Architectural Latex System:

a. Prime Coat: Alkali-resistant, water based primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior latex, high-performance architectural coating, semigloss.

3. Alkyd System:

a. Prime Coat: Alkali-resistant, water-based primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior alkyd, semigloss.

B. Steel Substrates:

1. Latex System, Alkyd Primer:

a. Prime Coat: Alkyd quick-dry primer for metal.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, semigloss.

2. Latex over Shop-Applied Quick-Drying Shop Primer System:

a. Prime Coat: Quick-dry primer for shop application.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, semigloss.

C. Fiberglass Substrates:

1. Latex System:

a. Prime Coat: Water-based bonding primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, semigloss.

3.7 INTERIOR PAINT SCHEDULE

A. a. PT-1:

1. Manufacturer: Sherwin Williams
2. Number: SW-9502
3. Color: Arrowroote

B. PT-2:

1. Manufacturer: Sherwin Williams
2. Number: SW-7602
3. Color: Indigo Batik

END OF SECTION 099123

SECTION 099726
CEMENTITIOUS COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of cementitious coating systems on the following substrates:

1. Interior concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: In each color and gloss of topcoat.

1. Submit Samples on rigid backing, not less than **8 inches** square, with mortar joint in center.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each cementitious coating, from manufacturer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency or performed by a qualified testing agency, for each product formulation.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are from same production run (batch mix) as materials applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent of each color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of coating system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one actual substrate of each type to represent surfaces and conditions for application of coating.

    a. Floor Surfaces: Prepare a test area minimum 2 by 2 feet in size to verify suitability of the sealer and final appearance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, new, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Manufacturer's stock number and date of manufacture.
3. Contents by volume, for pigment and vehicle constituents.
4. Application instructions.
5. Color name and number.
6. Handling instructions and precautions.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of **45 deg F**. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue.

1. Protect cementitious coating materials from freezing. Keep materials dry and storage area neat and orderly. Remove waste daily. Take necessary measures to ensure that workers and work areas are protected from health hazards resulting from handling, mixing, and applying the coating.

1.7 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F**.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 CEMENTITIOUS COATINGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Seal Krete, Clear-Seal Concrete Protective Sealer Satin or comparable product by one of the following:

1. Silpro Corporation

B. Products: Subject to compliance with requirements, provide one of the products listed in the Cementitious Coating Schedule for the paint category indicated.

C. Source Limitations: Obtain cementitious coating materials from single source and from single manufacturer.

D. Polymer-Modified Cementitious Coating: Containing portland cement, polymer, and hydrated lime or aggregates.

1. Compressive Strength: Not less than 3500 psi at 28 days according to ASTM C109/C109M.
2. Tensile Strength: Not less than 350 psi at 28 days according to ASTM C109/C109M.
3. Resistant to moisture, salt, chlorine, oil & hot tire pick-up.

E. Colors: Clear-Seal, satin.

F. Other Materials: Provide crack fillers, block fillers, and related materials that are compatible with cementitious finish-coat materials and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for mixing and preparing materials and as applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, incompatible coatings, and loose substrate materials.

D. Cementitious and Masonry Surfaces: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.

1. Cracks Larger Than **1/32 Inch**: Cut out static cracks, voids, or honeycombing larger than **1/32 inch** and patch with materials recommended in writing by coating manufacturer. Identify dynamic cracks and treat according to manufacturer's written instructions before beginning application.

3.3 APPLICATION

A. Apply coatings according to manufacturer's written instructions. Use applicators and techniques suited for coating and substrate indicated.

1. Dampen substrate of surfaces to receive cementitious coatings one hour before beginning application to prevent surface drag. Immediately before applying coatings, redampen substrate. Substrates shall be saturated and surface dry at time of application.
2. Brushes: Use Tampico or masonry brushes best suited for material being applied.
3. Spray Equipment: Use spray equipment recommended in writing by manufacturer for material and texture required.

B. Apply coating to achieve material thickness as recommended in writing by manufacturer, but not less than the following:

1. First Coat: Apply polymer-modified cementitious coating material at the rate of **2 lb/sq. yd.** to achieve a total cured thickness of **25 mils**.
2. Second Coat: Apply polymer-modified cementitious coating material at the rate of **1 lb/sq. yd.** to achieve a total cured thickness of **15 mils**.
3. Apply additional coats when undercoats or other conditions show through final coat until cured film is of uniform coating finish, color, and appearance.

C. On previously coated surfaces, apply coating to achieve material thickness as recommended in writing by manufacturer, but not less than the following:

1. Apply polymer-modified cementitious coating material at the rate of **1 lb/sq. yd.** to achieve a total cured thickness of **15 mils**.
2. Apply additional coats when undercoats or other conditions show through final coat until cured film is of uniform coating finish, color, and appearance.

D. Brush Application: Brush out and work brush coats into surfaces in an even film, filling all pores and voids at rate recommended in writing by manufacturer to achieve cured material thickness indicated. Finish coat with smooth, horizontal strokes.

E. Spray Application: Apply each coat according to manufacturer's written instructions to provide the equivalent hiding of brush-applied coats. Follow spray application with a general light brooming of coated surface to impart a slight texture.

3.4 FIELD QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coating operations are being conducted:

1. Owner will engage the services of a qualified testing agency to sample coating materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements specified.

3. Owner may direct Contractor to stop coating application if test results show materials being used do not comply with requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 CEMENTITIOUS COATING SCHEDULE

A. Above-Grade Concrete and Masonry:

1. Polymer-Modified Cementitious Coating:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Polymer-modified cementitious coating.

END OF SECTION 099726

SECTION 101423.16
ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Room-Identification Signs: Full-size Sample.
2. Variable Component Materials: 8-inch Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
3. Full-size Samples, if approved, will be returned to Contractor for use in Project.

E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings

or specified.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, and, manufacturer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design",ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASI Sign Systems, Inc
b. inpro Corporation
c. Mohawk Sign Systems

d. Substitutions: Under provisions of Section 012500

2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.

   a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
   b. Surface-Applied Graphics: Applied vinyl film.
   c. Color(s): As selected by Architect from manufacturer's full range.

3. Sign-Panel Perimeter: Finish edges smooth.

   a. Edge Condition at Vertical Edges: As indicated on Drawings.
   b. Corner Condition in Elevation: As indicated on Drawings.

4. Frame: Horizontal retainers.

   a. Material: Aluminum.
   b. Frame Depth: As indicated on Drawings.
   c. Profile: Square.
   d. Corner Condition in Elevation: Square.
   e. Finish and Color: As selected by Architect from manufacturer's full range.

5. Mounting: Manufacturer's standard method for substrates indicated with adhesive.
6. Text and Typeface: typeface matching Architect's sample. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

A. Aluminum Sheet and Plate: **ASTM B209**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: **ASTM B221**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. Exposed Metal-Fastener Components, General:

   a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
   b. Fastener Heads: Use oval countersunk screws and bolts with tamper-resistant

Allen-head slots unless otherwise indicated.

3. Sign Mounting Fasteners:

   a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
   b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, **0.045 inch** thick, with adhesive on both sides.

D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

E. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Accessibility: Install signs in locations on walls as indicated on Drawings, and, according to the accessibility standard.

C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
5. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
6. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose

debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.

3.2 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

SECTION 104416
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
   b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Babcock-Davis
b. Badger Fire Protection; a Carrier company
c. Guardian Fire Equipment, Inc
d. Kidde; Carrier Global Corporation
e. Nystrom, Inc.

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.
5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container See Drawings: UL-rated 10-A:120-B:C, 20-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Badger Fire Protection; a Carrier company
b. Guardian Fire Equipment, Inc
c. Kidde; Carrier Global Corporation
d. Nystrom, Inc.

2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 104416

SECTION 133419
METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel framing.
2. Foamed-insulation-core metal wall panels.
3. Accessories.

B. Related Requirements:

1. Section 083613 "Sectional Doors" for sectional vehicular doors in metal building systems.
2. Section 074113.13 "Formed Metal Roof Panels" for roof panels.
3. Section 074213.13 "Formed Metal Wall Panels".

1.2 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.3 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to metal building systems including, but not limited to, the following:

a. Condition of foundations and other preparatory work performed by other trades.
b. Structural load limitations.
c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
d. Required tests, inspections, and certifications.
e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.

2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:

    a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
    b. Structural limitations of purlins and rafters during and after roofing.
    c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
    d. Temporary protection requirements for metal roof panel assembly during and after installation.
    e. Roof observation and repair after metal roof panel installation.

3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:

    a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
    b. Structural limitations of girts and columns during and after wall panel installation.
    c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
    d. Temporary protection requirements for metal wall panel assembly during and after installation.
    e. Wall observation and repair after metal wall panel installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of metal building system component.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

    a. Louvers.

B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:

1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

    a. Show provisions for attaching platforms.

3. Metal Roof, and, Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.

    a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
    b. Show wall-mounted items including personnel doors, vehicular doors, windows,

louvers, and lighting fixtures.
c. Show translucent panels.

4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

a. Flashing and trim.
b. Gutters.
c. Downspouts.
d. Service walkways.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For the following products:

1. Panels: Nominal **12 inches** long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
2. Flashing and Trim: Nominal **12 inches** long. Include fasteners and other exposed accessories.
3. Vapor-Retarder Facings: Nominal **6-inch-** square Samples.
4. Windows: Full-size, nominal **12-inch-** long frame Samples showing typical profile.
5. Accessories: Nominal **12-inch-** long Samples for each type of accessory.

E. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.

1. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
2. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

F. Delegated Design Submittals: For metal building systems.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.

7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Erector Certificates: For qualified erector, from manufacturer.

E. Material Test Reports: For each of the following products:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Source quality-control reports.

G. Field quality-control reports.

H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

I. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to IAS AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect foam-plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL BUILDING SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Nucor Building Systems or comparable product by one of the following:

1. ACI Building Systems, Inc.
2. Metallic Building Systems, part of the Cornerstone Building Brands
3. Pinnacle Structures, Inc.
4. Varco-Pruden Buildings; a division of BlueScope Buildings North America, Inc.
5. Substitutions: Under provisions of Section 016000
6. Substitutions: Under provisions of Section 016000

B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.

B. Primary-Frame Type:

1. Rigid Modular: Solid-member, structural-framing system with interior columns.

C. End-Wall Framing:

1. Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns, load-bearing end-wall and corner columns and rafters.

D. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.

E. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.

F. Bay Spacing: As indicated on Drawings.

G. Roof Slope: 1/2 inch per 12 inches.

H. Roof System: Manufacturer's standard standing-seam, vertical-rib, metal roof panels.

1. Liner Panels: Tapered rib.

I. Exterior Wall System: Manufacturer's standard exposed-fastener, tapered-rib, metal wall panels.

1. Liner Panels: Tapered rib.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.

B. Structural Performance: Metal building systems to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."

1. Design Loads: As indicated on Drawings.
2. Deflection and Drift Limits:

a. Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
b. No greater than the following:

1) Purlins and Rafters: Vertical deflection of 1/240 of the span.
2) Girts: Horizontal deflection of 1/180 of the span.
3) Metal Roof Panels: Vertical deflection of 1/180 of the span.
4) Metal Wall Panels: Horizontal deflection of 1/180 of the span.
5) Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
6) Lateral Drift: Maximum of 1/200 of the building height.

C. Seismic Performance: Metal building system to withstand the effects of earthquake motions determined according to ASCE/SEI 7.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire-Resistance Ratings: Where assemblies are indicated to have a fire-resistance rating, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E119 or ASTM E108 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory," FM Global's "Approval Guide," or from the listings of another qualified testing agency.

F. Fire Propagation Characteristics: Exterior wall assemblies containing foam plastics pass NFPA 285 fire test.

G. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

H. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.

I. Air Infiltration for Metal Roof Panels: Air leakage of not more than **0.06 cfm/sq. ft.** when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

J. Air Infiltration for Metal Wall Panels: Air leakage of not more than **0.06 cfm/sq. ft.** when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

K. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

L. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

M. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 30.

N. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Hail Resistance: MH.

O. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 64 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

P. Energy Star Listing: Roof panels that are listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

Q. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged, solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged, Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

2.4 STRUCTURAL-STEEL FRAMING

A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
2. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
3. Frame Configuration: Single gable.
4. Exterior Column: Tapered.

E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:

1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.

F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins:

   a. C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum **2-1/2-inch-** wide flanges.

2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum **2 inch-** wide flanges.

   a. Depth: As required to comply with system performance requirements.

3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates,

steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.

4. Flange Bracing: Minimum **2-by-2-by-1/8-inch** structural-steel angles or **1-inch-** diameter, cold-formed structural tubing to stiffen primary-frame flanges.
5. Sag Bracing: Minimum **1-by-1-by-1/8-inch** structural-steel angles.
6. Base or Sill Angles: Manufacturer's standard base angle, minimum **3-by-2-inch**, fabricated from zinc-coated (galvanized) steel sheet.
7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

G. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.

H. Bracing: Provide adjustable wind bracing using any method as follows:

1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade **50**; or ASTM A529/A529M, Grade **50**; minimum **1/2-inch-** diameter steel; threaded full length or threaded a minimum of **6 inches** at each end.
2. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
3. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

I. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.

J. Materials:

1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade **50 or 55**; or ASTM A529/A529M, Grade **50 or 55**.
2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade **50 or 55**; or ASTM A529/A529M, Grade **50 or 55**.
3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade **50 or 55**; or ASTM A529/A529M, Grade **50 or 55**.
4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades **30 through 55**, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades **45 through 70**; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades **25 through 80**, or HSLAS, Grades **45 through 70**.
7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades **33 through 80**, or HSLAS or HSLAS-F, Grades **50 through 80**; with **G60** coating designation; mill phosphatized.
8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades **33**

through 80, or HSLAS or HSLAS-F, Grades **50 through 80**; with **G90** coating designation.

b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade **50 or 80**; with Class **AZ50** coating.

9. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated on Drawings and required for primary framing.
10. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; **ASTM A563** carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.

    a. Finish: Plain.

11. High-Strength Bolts, Nuts, and Washers, **Grade A325**: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts; **ASTM A563, Grade DH,** heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

    a. Finish: Plain.

12. High-Strength Bolts, Nuts, and Washers, **Grade A490**: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts[**or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends**]; **ASTM A563, Grade DH,** heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
13. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends; **ASTM A563, Grade DH,** heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1 hardened carbon-steel washers.

    a. Finish: Plain.

14. Headed Anchor Rods: ASTM F1554, Grade 36.

    a. Configuration: Straight.
    b. Nuts: **ASTM A563** heavy-hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: **ASTM F436** hardened carbon steel.
    e. Finish: Mechanically deposited zinc coating, ASTM B695, Class 50.

K. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

1. Clean and prepare in accordance with SSPC-SP2.
2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of **1 mil**.

    a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of **0.5 mil** on each side.

2.5 FOAMED-INSULATION-CORE METAL WALL PANELS

A. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Panel Thermal-Resistance Value (R-Value): R-25.
2. Facing Material: Fabricate panel with exterior and interior facings of same material and thickness. Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Exterior Surface: Smooth, flat.
    b. Exterior Finish: Two-coat fluoropolymer.
    c. Color: As selected by Architect from manufacturer's full range, Light Stone and Aztec Blue as indicated on drawings.

3. Panel Thickness: 8 inches.
4. Insulation Core: Modified polyisocyanurate or polyurethane foam using a non-CFC blowing agent, foamed-in-place or board type, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

    a. Closed-Cell Content: 90 percent when tested according to ASTM D6226.
    b. Density: **2.0 to 2.6 lb/cu. ft.** when tested according to ASTM D1622.
    c. Compressive Strength: Minimum **20 psi** when tested according to ASTM D1621.
    d. Shear Strength: **26 psi** when tested according to ASTM C273/C273M.

5. Fire-Test-Response Characteristics: Class A according to ASTM E108.
6. Surface-Burning Characteristics: Flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E84.

B. Finishes:

1. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    c. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a minimum dry film thickness of **0.2 mil** for primer and **0.8 mil** for topcoat.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil**.

2.6 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded

back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
2. Clips: Manufacturer's standard, formed from stainless steel sheet, designed to withstand negative-load requirements.
3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless steel sheet or nylon-coated aluminum sheet.
4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch-** thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide **1-inch** standoff; fabricated from extruded polystyrene.

C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch-** thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, **0.018-inch** nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, **0.018-inch** nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum **96-inch-** long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.

2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, **0.018-inch** nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum **10-foot-** long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

G. Louvers: Size and design indicated; self-framing and self-flashing. Fabricate welded frames from zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, **0.048-inch** nominal uncoated steel thickness; finished to match metal wall panels. Form blades from zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, **0.036-inch** nominal uncoated steel thickness; folded or beaded at edges, set at an angle that excludes driving rains, and secured to frames by riveting or welding. Fabricate louvers with equal blade spacing to produce uniform appearance.

1. Blades:

a. Fixed.
b. Adjustable type, with weather-stripped edges, and manually operated by hand crank or pull chain.

2. Bird Screening: Galvanized steel, **1/2-inch-** square mesh, **0.041-inch** wire; with rewirable frames, removable and secured with clips; fabricated of same kind and form of metal and with same finish as louvers.

a. Mounting: Interior face of louvers.

H. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

I. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
2. Fasteners for Metal Roof Panels:

a. Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
b. Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.

3. Fasteners for Metal Wall Panels:

a. Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with EPDM sealing washers bearing on weather side of metal panels.
b. Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless steel or zinc-alloy-steel hex washer head, with EPDM sealing washers bearing on weather side of metal panels.

4. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
5. Blind Fasteners: High-strength aluminum or stainless steel rivets.

6. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for **15-mil** dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
7. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
8. Metal Panel Sealants:

    a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
    b. Joint Sealant: ASTM C920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.7 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members to be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

1. Make shop connections by welding or by using high-strength bolts.
2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

1. Make shop connections by welding or by using non-high-strength bolts.
2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated

performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.8 SOURCE QUALITY CONTROL

A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.

1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.

a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

1. Engage land surveyor to perform surveying.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written instructions and drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.

    a. Joint Type: Snug tightened or pretensioned as required by manufacturer.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

H. Steel Joists and Joist Girders: Install joists, girders, and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Joint Installation:

a. Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.
b. Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
c. Weld joist seats to supporting steel framework.

5. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 DOOR AND FRAME INSTALLATION

A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.

B. Personnel Doors and Frames: Install doors and frames according to NAAMM-HMMA 840. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:

1. Between Doors and Frames at Jambs and Head: **1/8 inch**.
2. Between Edges of Pairs of Doors: **1/8 inch**.
3. At Door Sills with Threshold: **3/8 inch**.
4. At Door Sills without Threshold: **3/4 inch**.

C. Door Hardware:

1. Install surface-mounted items after finishes have been completed at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
4. Set thresholds for exterior doors in full bed of sealant complying with requirements for concealed mastics specified in Section 079200 "Joint Sealants."

3.5 WINDOW INSTALLATION

A. General: Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash,

and securely fasten in place according to manufacturer's written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.

1. Separate dissimilar materials from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440.

B. Set sill members in bed of sealant or with gaskets, for weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Mount screens directly to frames with tapped screw clips.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet** with no joints allowed within **24 inches** of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than **36 inches** o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with **1-1/2-inch** telescoping joints. Provide fasteners designed to hold downspouts securely **1 inch** away from walls; locate fasteners at top and bottom and at

approximately **60 inches** o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Tie downspouts to underground drainage system indicated.

E. Louvers: Locate and place louver units level, plumb, and at indicated alignment with adjacent work.

1. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
2. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
3. Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of corrosion-resistant paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
4. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.

B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 ADJUSTING

A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.

B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.

C. Adjustable Louvers: After completing installation, including work by other trades, lubricate, test, and adjust units to operate easily, free of warp, twist, or distortion as needed to provide fully functioning units.

1. Adjust louver blades to be weathertight when in closed position.

3.9 CLEANING AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged

during construction period.

C. Touchup Painting:

1. After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.

    a. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
    b. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

2. Cleaning and touchup painting are specified in Section 099123 "Interior Painting."

D. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

E. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.

1. Immediately before final inspection, remove protective wrappings from doors and frames.

F. Windows: Clean metal surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances. Clean factory-glazed glass immediately after installing windows.

G. Louvers: Clean exposed surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

1. Restore louvers damaged during installation and construction period so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

    a. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 133419

SECTION 20 05 00 - MECHANICAL GENERAL REQUIREMENTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this Section.

1.02 SUMMARY

A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

1.03 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied

directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
3. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
4. ABMA - American Boiler Manufacturers Association; www.abma.com.
5. AGA - American Gas Association; www.aga.org.
6. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
7. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
8. ANSI - American National Standards Institute; www.ansi.org.
9. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
10. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
11. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
12. ASTM - ASTM International; www.astm.org.
13. AWS - American Welding Society; www.aws.org.
14. AWWA - American Water Works Association; www.awwa.org.
15. CDA - Copper Development Association; www.copper.org.
16. CGA - Compressed Gas Association; www.cganet.com.
17. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
18. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
19. CSI - Construction Specifications Institute (The); www.csiresources.org.
20. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
21. FM Approvals - FM Approvals LLC; www.fmglobal.com.
22. HI - Hydraulic Institute; www.pumps.org.
23. ICC - International Code Council; www.iccsafe.org.
24. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
25. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
26. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
27. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org
28. NADCA - National Air Duct Cleaners Association; www.nadca.com.
29. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
30. NEBB - National Environmental Balancing Bureau; www.nebb.org.
31. NECA - National Electrical Contractors Association; www.necanet.org.
32. NEMA - National Electrical Manufacturers Association; www.nema.org.
33. NETA - InterNational Electrical Testing Association; www.netaworld.org.
34. NFPA - National Fire Protection Association; www.nfpa.org.
35. NSF - NSF International; www.nsf.org.
36. NSPE - National Society of Professional Engineers; www.nspe.org.
37. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
38. STI - Steel Tank Institute; www.steeltank.com.
39. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.

40. UL - Underwriters Laboratories Inc.; www.ul.com.
41. USGBC - U.S. Green Building Council; www.usgbc.org.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.04 PERFORMANCE REQUIREMENTS

A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.05 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.

1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.
2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner's Representatives causes interference.

G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.06 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.

B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

D. Refer to Division 22 Section "Domestic Water Piping" for purchase and installation of potable water meters.

1.07 DRAWINGS

A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.

C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or

differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.08 MATERIAL AND EQUIPMENT MANUFACTURERS

A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.

C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.

D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.09 INSPECTION OF SITE

A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 ACTION SUBMITTALS

A. Submit for review in compliance with Division 01.

B. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.

C. Submittals shall be in groupings of similar or related items. Plumbing fixture submittals shall be in one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned “Rejected”. Submit product data with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.

D. Submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned “Rejected”.

E. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be included with the submittal for approval.

1.12 INFORMATIONAL SUBMITTALS

A. Shop Drawings:

1. Prepare shop drawings to scale for the Architect/Engineer for review.
2. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
3. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.

    a. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
    b. Contractor is responsible for:

        1) Dimensions, which shall be confirmed and correlated at the job site.
        2) Fabrication processes and techniques of construction.
        3) Quantities.
        4) Coordination of Contractor's work with all other trades.
        5) Satisfactory performance of Contractor's work.
        6) Temporary aspects of the construction process.

1.13 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Instructional Manuals:

1. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
2. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
3. For Commissioned Projects: Operation and maintenance instructional manuals shall be submitted a minimum of four weeks prior to functional testing.
4. Format: Submit operation and maintenance manuals in the following format:

    a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
2) Enable inserted reviewer comments on draft submittals.

5. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:

a. Routine maintenance procedures.
b. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
c. Trouble-shooting procedures.
d. Contractor's telephone numbers for warranty repair service.
e. Submittals.
f. Recommended spare parts list.
g. Names and telephone numbers of major material suppliers and subcontractors.
h. System schematic drawings.

B. Record Drawings:

1. Submit record drawings in compliance with Division 01.
2. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
3. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

C. Warranties:

1. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
2. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.14 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.

E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 WARRANTY

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 REFRIGERANT HANDLING

A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:

1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.
2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.

B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

3.02 WORK IN EXISTING BUILDINGS

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement, if necessary, of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.03 TEMPORARY SERVICES

A. Provide temporary service as described in Division 01.

B. The existing building will be occupied during construction. Maintain mechanical services and provide necessary temporary connections and their removal at no additional cost to the Owner.

3.04 WORK INVOLVING OTHER TRADES

A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.05 ACCEPTANCE PROCEDURE

A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.

B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.

D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

E. Operation of the following systems shall be demonstrated:

1. Air Handling Systems.
2. Refrigeration Systems.
3. Heating Systems.
4. Compressed Air Systems.
5. Temperature Controls.
6. Building Automation System.

F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

3.06 PROJECT COMMISSIONING

A. Refer to Division 01 “Project Commissioning” and the Commissioning Manual.

B. Purpose: Training, documentation and verification of the operation and functional performance of mechanical systems for compliance with the “design intent.”

END OF SECTION 20 05 00

SECTION 20 05 10 - BASIC MECHANICAL MATERIALS AND METHODS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 22 Section “Domestic Water Piping” for flushing and cleaning of potable water piping.
3. Division 23 Section “Piping Systems Flushing and Chemical Cleaning” for flushing and cleaning of HVAC piping.

1.02 SUMMARY

A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheet metal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.

4. PVC: Polyvinyl chloride plastic.
5. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
6. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

C. Comply with NSF 372, “Drinking Water System Components – Lead Content” for potable domestic water piping and components.

D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. Duct Joint and Seam Welding: Qualify procedures and personnel according to the following:

1. AWS D9.1, "Sheet Metal Welding Code."

F. Structural Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

5. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

G. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

H. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."

I. Installer Qualifications:

1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.
2. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.

1. Protect equipment and materials from theft, injury or damage.
2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.

D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.

1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.

B. Unions: Pipe Size 2 Inches and Smaller:

1. Ferrous pipe: Malleable iron ground joint type unions.
2. Unions in galvanized piping system shall be galvanized.
3. Copper tube and pipe: Bronze unions with soldered joints.

C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:

1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
2. Copper tube and pipe: Slip-on bronze flanges.

D. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.

F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

G. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.

H. Brazing Filler Metals: Alloys meeting AWS A5.8.

1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.

I. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

J. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

K. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

L. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

M. Solvent Cements for Joining ABS Piping: ASTM D 2235.

N. Solvent Cements for Joining PVC to ABS Piping Transition: ASTM D 3138.

O. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 PIPE THREAD COMPOUNDS

A. General: Pipe thread compounds for the fluid service compatible with piping materials provided.

B. Potable Water Service and Similar Applications: Compounds acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.

C. Natural Gas System: Use either of the following:

1. Tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for threaded joints.

a. Manufacturers:

1) Cadillac Plastic.
2) Permacel.
3) Other approved.

2. Lead-free pipe thread compounds suitable for service.

a. Manufacturers:

1) HCC Holdings, Inc.; Hercules Pro Dope.
2) Mill-Rose Company (The); Clean-Fit Products; Blue Monster Thread Sealant.
3) Oatey; Great Blue Pipe Joint Compound.
4) RectorSeal LLC: A CSW Industrials Company; No. 5, No.5 Special, and No. 5 Sub-Zero Pipe Thread Sealants.

2.05 TRANSITION.FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. IPEX Inc. (formerly Eslon Thermoplastics).

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.
e. Can-Tex Industries Division of Harsco Corp. “CT-Adaptors”.
f. Joint Inc., “Caulder”.

2.06 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.

D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Capitol Manufacturing Co.
    d. GF Piping Systems; George Fischer Central Plastics.
    e. Epco Sales, Inc.
    f. Pipeline Seal and Insulator, Inc.
    g. Watts Water Technologies, Inc.; Watts Regulator Co.
    h. Zurn Industries, Inc.; Wilkins Div.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.

1. Manufacturers:

    a. ASC Engineered Solutions; Gruvlok Manufacturing; DI-LOK Nipples.
    b. Elster Group; Perfection Corp.; ClearFlow.
    c. Precision Plumbing Products, Inc.; ClearFlow.
    d. Sioux Chief Manufacturing Co., Inc.
    e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
    f. Victaulic Co. of America; Style 47 ClearFlow.

2.07 MODULAR MECHANICAL SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.

1. Manufacturers:

    a. Advance Products & Systems, Inc.; Innerlynx.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.08 SLEEVES

A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.

B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.

C. Water Stop: Cast or ductile-iron; fabricated steel; PVC; or rotationally molded HDPE pipe; with plain ends and integral water stop, unless otherwise indicated.

1. Manufacturers:

a. Advance Products & Systems, Inc.; Infinity and Gal-Vo-Plast Sleeves.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.09 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2. Existing Piping: Use the following:

a. Chrome-Plated Piping or Piping in High Humidity Areas: Split-casting, cast-brass type with chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
c. Bare Piping: Split-plate, stamped-steel type with set screw or spring clips.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.11 EPOXY BONDING COMPOUND

A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.

B. Manufacturers:

1. Euco 452 #450; Euclid Chemical Co.
2. Epobond; L & M Construction Chemicals.
3. Sikadur 87; Sika Corp.

2.12 LEAK DETECTOR SOLUTION

A. Commercial leak detector solution for pipe system testing.

B. Manufacturers:

1. American Gas and Chemicals Inc.; Leak Tec.
2. Cole-Parmer Inst. Co.; Leak Detector.
3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Refer to piping application schedules on the Drawings.

B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer’s instructions.

C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. The Drawings shall be followed as closely as elements of construction will permit.

D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.

E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.

F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

H. Clean and lubricate elastomer joints prior to assembly.

I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

J. Install piping to conserve building space and not interfere with use of space.

K. Group piping whenever practical at common elevations.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.

M. Slope piping and arrange systems to drain at low points.

N. Slope horizontal piping containing non-condensable gases 1 inch per 100 feet, upward in the direction of the flow.

O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

P. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.

R. Do not penetrate building structural members unless specifically indicated on drawings.

S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.

T. Install valves with stems upright or horizontal, not inverted.

U. Provide clearance for installation of insulation and access to valves and fittings.

V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.

W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.

X. Install piping free of sags and bends.

Y. Install fittings for changes in direction and branch connections.

Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:

1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.

AA. Install piping to allow application of insulation.

BB. Select system components with pressure rating equal to or greater than system operating pressure.

CC. After completion, fill, clean, and treat systems. Refer to Division 23 Sections “Hydronic Piping,” “Piping Systems Flushing and Chemical Cleaning,” and “HVAC Water Treatment.”

DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.

EE. Sleeves are not required for core-drilled holes in poured concrete walls.

FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.

GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces of walls.

    a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
    b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
    c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
    d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
    e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.

4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
5. Seal sleeves in plaster/gypsum-board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.

1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

II. New, Poured Concrete, Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Install water stop sleeves prior to pour. Seal pipe penetrations using modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.

1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

JJ. Existing Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Seal core drilled pipe penetrations using modular mechanical seals. Allow for 1-inch annular clear space between pipe and cored opening for installing modular mechanical seals.

1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of cored hole. Assemble modular mechanical seals and install in annular space between pipe and cored opening. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

KK. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.
2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.

LL. Pipe Roof Penetration Enclosures:

1. Coordinate delivery of roof penetration enclosures to jobsite.
2. Locate and set curbs on roof.
3. Framing, flashing, and attachment to roof structure are specified under Division 07.
4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.

MM. Verify final equipment locations for roughing-in.

NN. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

B. Cut piping square.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.

E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.

G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets,

furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.

H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.

I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.

J. Provide temperature sensing device thermal wells and similar piping specialty connections.

K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.

L. Locate instrument connections in accordance with manufacturer's instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.

M. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

O. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.

1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.

2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.

R. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

S. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

T. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

U. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.

V. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

W. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

X. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

Y. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

Z. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

AA. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.03 ACCESS DOORS

A. Provide access doors for installation by architectural trades. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section “Access Doors and Frames” for manufacturers and model numbers and additional information.

B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

3.04 EQUIPMENT CONNECTIONS

A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.

1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer’s submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.

B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.05 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.06 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.

F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.

G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer’s name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.07 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.08 CONCRETE BASES

A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.

B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.

1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.09 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Where pipe and/or equipment support members must be welded to structural building framing, Contractor shall seek prior approval from Architect and structural engineer. Scrape, brush clean, and apply one coat of zinc rich primer after welding.

D. Field Welding: Comply with AWS D1.1.

3.10 EPOXY BONDING TO EXISTING MATERIALS

A. Use epoxy bonding compound to set sleeves or pipes in existing concrete to bond new concrete and/or grout to existing materials or to bond dissimilar materials.

B. The compound, when applied in accordance with the manufacturer's instructions, shall be capable of initial curing within 48 hours at temperatures as low as 40 deg F and shall be capable of bonding any combination of the following properly prepared materials: Wet or dry, cured or uncured concrete or mortar; vitrified clay; cast iron and carbon steel.

3.11 JACKING OF PIPE

A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.12 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.13 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.14 CUTTING, CORING AND PATCHING

A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.

B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.15 EXCAVATION AND BACKFILLING

A. Refer to Division 31 Specification Sections.

B. Provide all excavation, trenching, tunneling and backfilling required for the mechanical work.

C. Provide all pumping and/or well pointing required for the mechanical work.

D. Provide foundations if required to support underground piping.

E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in

layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

3.16 FLASHING

A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.17 LUBRICATION

A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.18 FILTERS

A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.

B. Immediately prior to final building acceptance by the Owner, Contractor shall:

1. Thoroughly wash, recharge and reinstall cleanable type air filters.
2. Replace all disposable type air filters with new units.

3.19 CLEANING

A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

B. After equipment, steam, condensate and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

C. Prior to connection of new HVAC piping to existing HVAC piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

D. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section "Domestic Water Piping."

E. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.

F. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION 20 05 10

SECTION 20 05 13 - MOTORS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
3. Division 20 Section “Variable Frequency Controllers”.
4. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
5. Division 26 Section “Enclosed Switches and Circuit Breakers”.
6. Division 26 Section “Enclosed Controllers”.
7. Division 26 Section “Fuses”.

1.02 SUMMARY

A. This Section includes basic requirements for factory-installed motors.

1.03 DEFINITIONS

A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)

B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

C. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

D. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.04 CLOSEOUT SUBMITTALS

A. Test Reports: Written reports specified in Parts 2 and 3.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

B. Source Limitations: Obtain field-installed motors of a single type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:

a. Magnetic controllers.
b. Multispeed controllers.
c. Reduced-voltage controllers.
d. Solid-state controllers.
e. Variable frequency controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate electrical scope of work to be provided by Division 20, 21, 22, and 23 with this Section, related Division 20, 21, 22, and 23 Specifications, Division 26 Specifications and the Drawings.

C. Electrical work provided under Division 20, 21, 22, and 23: Furnish UL Listed components in accordance with this section, Division 26, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.

D. Furnished, installed and wired under Division 20, 21, 22, and 23 unless otherwise indicated:

1. Disconnected components in packaged self-contained equipment that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.

E. Furnished and installed under Division 20, 21, 22, and 23 and wired under Division 26 unless otherwise indicated:

1. Motors required for mechanical equipment
2. Packaged Self-Contained Equipment:

a. Provide equipment ready to accept a single electrical service connection.
b. For equipment with remote mounted control panels, provide mounting of the control panel and external wiring from the control panel to the package self-contained equipment.

3. Variable frequency controllers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Dayton.
2. Toshiba Intl.
3. Baldor Electric/Reliance.
4. Rockwell Automation/Allen-Bradley.
5. Nidec Motor Corporation; U.S. Electrical Motors.
6. Regal Beloit/GE Commercial Motors.
7. Regal Beloit/Leeson.
8. Regal Beloit/Marathon.
9. Siemens.

2.02 MOTOR REQUIREMENTS

A. Motor requirements apply to factory-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.
2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.

B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.

2.03 MOTOR CHARACTERISTICS

A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.

B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.

I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.04 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

	1800 RPM OPEN DRIP-PROOF MOTORS 4 POLE		1800 RPM ENCLOSED MOTORS 4 POLE	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM
HP	EFF	EFF	EFF	EFF
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM
HP	EFF	EFF	EFF	EFF
1	80	78.5	--	--
1.5	84	82.5	82.5	81.5

	1800 RPM OPEN DRIP-PROOF MOTORS 4 POLE		1800 RPM ENCLOSED MOTORS 4 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4
100	94.1	93.6	93	92.4
125	94.1	93.6	93.6	93
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts for 5kV or Less (Form Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

D. Stator: Copper windings, unless otherwise indicated.

E. Rotor: Squirrel cage, unless otherwise indicated.

F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation:

1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.
2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.
3. Fire Pump Motors: NEMA starting Code (KVA Code) B.

J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.

1. Finish: Gray enamel.

K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.05 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Furnish for equipment where specified or scheduled with ECM.

1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
6. Integrated motor protection verified by UL to protect equipment against over-/undervoltage, overtemperature of motor, electronics, or both, overcurrent, locked rotor, and dry run (no-load condition).

2.06 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

2.07 ENCLOSED CONTROLLERS

A. Provide enclosed controllers in accordance with requirements specified in Division 26 Section “Enclosed Controllers”.

2.08 Enclosed switches and circuit breakers

A. Provide enclosed switches and circuit breakers in accordance with requirements specified in Division 26 Section “Enclosed Switches and Circuit Breakers”.

2.09 FUSES

A. Provide fuses in accordance with requirements specified in Division 26 Section “Fuses”.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ENCLOSED CONTROLLER INSTALLATION

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks.

B. Install freestanding equipment on concrete bases. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

C. Enclosed Controller Fuses: Install fuses in each fusible switch. Arrange fuses so rating information is readable without removing fuse.

D. Install motor control equipment and contactors in accordance with manufacturer’s instructions.

E. Select and install heater elements in motor starters to match installed motor characteristics.

F. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

G. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

H. Mount individual wall-mounting switches and circuit breakers with tops at uniform heights, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

I. Install disconnect switches with off position down.

J. Install NEMA KS 1 enclosed switch where indicated for motor loads 1/2HP and larger and equipment loads greater than 30A.

K. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than 1/2 HP and equipment loads 30A. and less.

L. Install fuses in fusible disconnect switches. Arrange fuses so rating information is readable without removing fuse.

M. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.

3.03 FIELD QUALITY CONTROL

A. All three phase motors 1/2 HP and above shall be tested by the Testing Agency.

B. Prepare for acceptance tests as follows:

1. Check motor nameplates for horsepower, speed, phase and voltage.
2. Check coupling alignment and shaft end play.
3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control features for proper operation.
5. Verify that current in each phase is within nameplate rating.

C. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
2. Jog motor as required to verify proper phase and shaft rotation. Immediately after start-up, check bearing temperature and smooth operation. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine reason for discrepancy and take necessary corrective actions. Record all readings, motor nameplate data and overload heater data.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with requirements.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Verify bearing lubrication.
4. Verify proper motor rotation.
5. Test Reports: Prepare a written report to record the following:

a. Test procedures used.
b. Test results that comply with requirements.

c. Test results that do not comply with requirements and corrective action taken to achieve compliance.

3.04 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

B. Set field adjustable switches and circuit breaker trip ranges.

3.05 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 20 05 13

SECTION 20 05 29 - HANGERS AND SUPPORTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 20 Section “Basic Mechanical Materials and Methods.”
4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
5. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops" for pipe guides and anchors.
6. Division 21 Section "Fire-Suppression System" for pipe hangers for fire-protection piping.

7. Division 23 Section(s) "Metal Ducts" for duct hangers and support.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. MFMA: Metal Framing Manufacturers Association.

1.03 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

1.05 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

1.06 QUALITY ASSURANCE

A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:

1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture, Selection, Application, and Installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 HANGER ROD MATERIAL

A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.

1. Rod continuously threaded.
2. Use of rod couplings is prohibited.

2.03 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.

1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.

B. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. Hilti USA.
5. nVent Electric plc; CADDY.
6. PHD Manufacturing, Inc.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.04 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.05 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. Anvil; Anvil-Strut; ASC Engineered Solutions.
2. B-Line by Eaton.
3. nVent Electrical plc; ERISTRUT Div.
4. Power-Strut; a part of Atkore International.
5. Unistrut; a part of Atkore International.
6. Hilti USA.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

E. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.06 METAL INSULATION SHIELDS

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 40, protective shields. Shields shall span an arc of 180 degrees.

C. Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.

2.07 PIPE COVERING PROTECTION SADDLES

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.

1. Saddles shall match insulation thickness.
2. Saddle length: 12 inches.
3. Furnish with center rib for pipe sized NPS 12 and larger.

2.08 FASTENER SYSTEMS

A. Post-Installed Anchors:

1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

a. Manufacturers:

1) B-Line by Eaton.
2) DeWalt Engineered by Powers.
3) Hilti, Inc.
4) ITW Ramset/Red Head.
5) MKT Fastening, LLC.

2. Internally Threaded Screw Anchors: Internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck.

a. UL Listed or FMG approved for fire sprinkler piping.
b. Available Sizes: For 1/4-inch, 3/8-inch, and 1/2-inch diameter rod sizes
c. Manufacturers:

1) B-Line by Eaton; Rapid Rod Hangers.
2) DeWalt Engineered by Powers; Snake+.

3. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application. Exception: Do not use chemical fasteners to support hanger systems for fire protection piping.

a. Manufacturers:

1) DeWalt Engineered by Powers.
2) Hilti, Inc.
3) ITW Ramset/Red Head.
4) MKT Fastening, LLC.

b. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
c. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
d. Washer and Nut: Zinc-coated steel.

B. Cast-in-Place Anchors:

1. Threaded Inserts: Galvanized malleable iron or galvanized steel for 3/4 inch bolts.

a. Manufacturers:

1) B-Line by Eaton.
2) DeWalt Engineered by Powers.
3) Empire Industries, Inc.
4) Hilti, Inc.
5) ITW Ramset/Red Head.
6) MKT Fastening, LLC.
7) Richmond Screw Anchor Co.

2. Slotted Inserts: Continuous galvanized steel with temporary slot fillers and complete with nuts, studs, washers and the like, for 3/4 inch bolts.

a. Manufacturers:

1) B-Line by Eaton; B22-I Continuous Concrete Insert.
2) Hilti, Inc.; CIS13812/PG.
3) Hohman and Barnard, Inc.
4) Richmond Screw Anchor Co.
5) Unistrut; a part of Atkore International; P-3200 Continuous Insert.

2.09 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Refer to application schedules on the Drawings.

B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.

C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

D. Comply with MSS SP-58 for pipe hanger selections and applications that are not specified in piping system Sections.

E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.

F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.

G. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.

H. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

I. Use padded hangers for piping that is subject to scratching.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. MSS Type 8 or spring type to meet system requirements.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Concrete Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Anchor Devices, Concrete and Masonry: in accordance with Group I, Group II, Type 2, Class 2, Style 1 and Style 2, Group III and Group VIII or FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry, unless otherwise approved by the Architect. Powder actuated anchoring devices shall not be used to support any mechanical systems components.
2. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
3. Use mechanical-expansion anchors where required in concrete construction.
4. Use chemical fasteners where required in concrete construction.

M. Steel Frame Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Beam Clamps:

    a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
    b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.

N. Hanger-Rod Attachments for Wood Construction: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. All Steel Ceiling Plates: UL listed and suitable for attachment to wood beams. For pipe sizes NPS 1/2 to NPS 2. Install in accordance with manufacturer's instructions to maintain listing.
2. Threaded Side Beam Brackets: UL listed and FMG approved, suitable for attachment to wood beams. For pipe sizes NPS 2 to NPS 4. Install in accordance with manufacturer's instructions to maintain listing.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Use spring supports and sway braces TYPES 48, 49, 50, 51, 52, 53, 54, 55 or 56. For specific points:

    a. Provide spring supports at point of support where vertical movement will occur.
    b. For light loads and vertical movement less than 1/4 inch, TYPES 48 or 49 spring cushion supports.
    c. For vertical movements in excess of 1/4 inch but less than 1/2 inch, TYPES 51, 52 or 53 variable spring supports shall be used, loaded to not more than 75 percent of published load rating.
    d. For vertical movements of 1/2 inch and more, TYPES 54, 55 and 56 constant support spring hangers.
    e. Sway braces; TYPE 50.
    f. Variable spring hangers in accordance with referenced MSS Standards with "medium" allowable load change.

P. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.

B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.

C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.

D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.

E. File and paint cut ends and shop or field prime paint supporting element components.

F. Secure Type 40 shields to support elements in a manner that prevents movement and damage to insulation and jacket materials.

G. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.

H. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.

I. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.

J. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment.

K. Where necessary, brace piping and supports against reaction, sway and vibration.

L. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.

M. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.

N. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not

over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.

O. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.

P. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.

Q. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.

R. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.

S. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.

T. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.

U. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.

V. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.

W. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.

X. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.

Y. Building structure shall not be reinforced except as approved by the Architect in writing.

Z. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor in accordance with applicable codes but in no case less than 5. Coordinate installation of all imbedded items in accordance with manufacturer's instructions. Position anchorage and imbedded items as indicated and/or where required and support against displacement during placing of concrete. Cutting or

repositioning of concrete beam or girder or reinforcing steel to accommodate inserts will not be allowed. Provide removable closures in imbedded device openings to prevent entry of concrete.

AA. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.

BB. Use cast-in-place inserts in concrete beams and girders. Drilled anchors/wedge type inserts shall be used on vertical surfaces only. Coordinate with structural engineer.

CC. Attach piping supports to the side of concrete beams and concrete joist. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete beams and concrete joist.

DD. Attach piping supports to the side of concrete beams or concrete joist. Where intermediate hangers are required to meet the hanger spacing schedule, the Contractor may propose attachment of intermediate pipe supports to the bottom of the concrete slab pending submittal of a satisfactory pull out test. The Contractor shall submit pull out test criteria, pull out test results, proposed hanger detail and hanger point loads to the Architect for written approval.

EE. Trapeze Pipe Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

FF. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

GG. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

HH. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

II. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

JJ. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

KK. Install lateral bracing with pipe hangers and supports to prevent swaying.

LL. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger

and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

MM. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

NN. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

OO. Refer to individual piping sections for hanger spacing and hanger rod sizes.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Equipment Supports: Painting is specified in Division 09 painting Sections.

C. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 20 05 29

SECTION 20 05 53 - MECHANICAL IDENTIFICATION

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Samples: For color, letter style, and graphic representation required for each identification material and device.

B. Valve numbering scheme.

1.04 CLOSEOUT SUBMITTALS

A. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.05 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.06 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. Seton.
2. Brady.
3. EMED.
4. Craftmark.
5. Brimar Industries, Inc.
6. Marking Services Inc. (MSI).
7. Kolbi Pipe Marker Co.

2.02 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:

a. Name and plan number.
b. Equipment service.
c. Design capacity.
d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: Minimum 1/16 inch, unless otherwise indicated.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.03 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
3. Legends: Spelled out in full or commonly used and accepted abbreviations.

4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

F. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.

G. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.04 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

B. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

2.05 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect/Engineer. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick brass.
2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

2.06 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.07 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.01 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.

4. Fans, blowers, primary balancing dampers, and mixing boxes.
5. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Fire department hose valves and hose stations.
    c. Meters, gages, thermometers, and similar units.
    d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
    e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    g. Fans, blowers, primary balancing dampers, and mixing boxes.
    h. Packaged HVAC central-station and zone-type units.
    i. Tanks and pressure vessels.
    j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with equipment markers in the following color codes:

    a. Green: For cooling equipment and components.
    b. Yellow: For heating equipment and components.
    c. Orange: For combination cooling and heating equipment and components.
    d. Brown: For energy-reclamation equipment and components.

2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

4. Include signs for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
    c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    e. Fans, blowers, primary balancing dampers, and mixing boxes.
    f. Packaged HVAC central-station and zone-type units.
    g. Tanks and pressure vessels.
    h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

D. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.03 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.04 DUCT IDENTIFICATION

A. Install engraved duct markers with permanent adhesive on air ducts in the following color codes:

1. Refer to Schedule.
2. ASME (ANSI) A13.1 Colors and Designs: For hazardous material exhaust.
3. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

B. Identify ductwork with vinyl markers and flow direction arrows.

C. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:

a. Cold Water: Minimum 1-1/2 inches, round or square.
b. Hot Water: Minimum 1-1/2 inches, round or square.
c. Fire Protection: Minimum 1-1/2 inches, round or square.
d. Gas: Minimum 1-1/2 inches, round or square.
e. Steam: Minimum 1-1/2 inches, round or square.

3.06 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.07 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.08 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.09 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.10 SCHEDULES

A. Paint colors are listed here for reference only. Painting is specified under Division 9.

PIPE LABELING AND COLOR CODING

Pipe System Label	Drawing Abbrev.	Labels	Piping
Sanitary Sewer	SAN	White on Green	Dark Brown
Sanitary Vent	V	White on Green	Dark Brown
Rain Conductor	RC	White on Green	Dark Brown
Acid Waste	AW	Black on Yellow	Black
Acid Vent	AV	Black on Yellow	Black
Domestic Cold Water	CW	White on Green	Light Green
High Pressure Domestic Cold Water	HPCW	White on Green	Light Green
Non-Potable Cold Water	NPCW	Black on Yellow	
Domestic Hot Water	HW	Black on Yellow	Dark Green
High Pressure Domestic Hot Water	HPHW	Black on Yellow	Dark Green
High Pressure Domestic Hot Water Return	HPHWR	Black on Yellow	Dark Green
Domestic Hot Water Return	HWR	Black on Yellow	Dark Green
Soft Cold Water	SCW	White on Green	Light Green
Soft Hot Water	SHW	White on Green	Dark Green
Soft Hot Water Return	SHWR	White on Green	Dark Green
Natural Gas	G	Black on Yellow	Yellow
Fuel Oil Supply	FOS	Black on Yellow	Yellow
Fuel Oil Return	FOR	Black on Yellow	Yellow
Compressed Air (90psig)	A(90psig)	Black on Yellow	Dark Blue
Compressed Air (25psig)	A	White on Green	Dark Blue
Laboratory Vacuum	LVAC	Black on Yellow	Unpainted
Carbon Dioxide	CO_2	Black on Yellow	Unpainted
High Purity Water	DI	White on Green	White
Hot Water Htg. Supply	HWHS	Black on Yellow	Dark Blue

Pipe System Label	Drawing Abbrev.	Labels	Piping
Hot Water Htg. Return	HWHR	Black on Yellow	Dark Blue
Terminal Unit Heating Sup.	THS	Black on Yellow	Dark Blue
Terminal Unit Heating Ret.	THR	Black on Yellow	Dark Blue
Animal Heating Supply	AHS	Black on Yellow	Dark Blue
Animal Heating Return	AHR	Black on Yellow	Dark Blue
Energy Recovery Loop Sup.	ERLS	Black on Yellow	Dark Blue
Energy Recovery Loop Ret.	ERLR	Black on Yellow	Dark Blue
Chilled Water Supply	CHWS	White on Green	Light Blue
Chilled Water Return	CHWR	White on Green	Light Blue
Condenser Water Supply	CWS	White on Green	Light Green
Condenser Water Return	CWR	White on Green	Light Green
Process Cooling Water Sup.	PCWS	White on Green	Light Green
Process Cooling Water Ret.	PCWR	White on Green	Light Green
Refrigerant Liquid	RL	Black on Yellow	
Refrigerant Suction	RS	Black on Yellow	
Steam Condensate	LPC	Black on Yellow	Aluminum
Medium Pressure Steam Condensate	MPC	Black on Yellow	Aluminum
High Pressure Steam Condensate	HPC	Black on Yellow	Aluminum
Pumped Steam Condensate	PC	Black on Yellow	Aluminum
Medium Pressure Steam (60 psig)	MPS	Black on Yellow	Aluminum
High Pressure Steam	HPS	Black on Yellow	Aluminum
Low Pressure Steam (5 psig)	LPS	Black on Yellow	Aluminum
Fire Protection	FP	White on Red	Bright Red
Medical Gases	Refer to Division 22 Section “Medical Gas Systems.”		

SHEET METAL WORK

Service	Abbrev.	Labels	Ductwork
Air Conditioning Supply	Supply Air	White on Green	White
Air Conditioning Return	Return Air	White on Green	White
Exhaust Systems	Exhaust Air	Black on Yellow	Green
Outside Air Intake	Outside Air	White on Green	White
Mixed Air	Mixed Air	White on Green	White

END OF SECTION 20 05 53

SECTION 20 07 00 - MECHANICAL INSULATION

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section “Hanger and Supports” for thermal hanger shield inserts.
4. Division 22 Section “Plumbing Fixtures: for protective shielding guards.
5. Division 22 Section “Healthcare Plumbing Fixtures” for protective shielding guards.
6. Division 23 Section "Metal Ducts" for duct liners.

1.02 SUMMARY

A. This Section includes mechanical insulation for pipe, duct, and equipment.

1.03 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. PSK: Polypropylene, scrim, kraft paper.

D. PVC: Polyvinyl Chloride.

E. SSL: Self-sealing lap.

1.04 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

B. Existing Plastic Water Piping Within Return Air Plenum Space:

1. All Pipe Sizes: Fire-Rated Plenum Wrap: 1/2 inch thick.

1.05 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.06 FIELD-APPLIED JACKETING SYSTEMS DESCRIPTION

A. Acceptable field-applied jacketing materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe specialty.

1.07 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1. ESR Report: For fire-rated grease duct insulation.

1.08 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer’s original packaging.

1.10 COORDINATION

A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.11 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS, GENERAL REQUIREMENTS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.02 PIPE INSULATION MATERIALS

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
b. Armacell LLC; AP Armaflex.
c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.

B. Glass-Fiber, Preformed Pipe Insulation, Type I:

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000 Pipe Insulation.
c. Manson Insulation Inc.; Alley-K.
d. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

C. Mineral-Wool, Preformed Pipe Insulation, Type II:

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. Johns Manville.
    b. Owens Corning/Thermafiber.
    c. Rock Wool Manufacturing Company; Delta PC and PF.

2. Type II, 1200 deg F Materials: Mineral wool fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied, or field-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article. Field-applied jacket requirements are specified in Part 2 "Field-Applied Jackets" Article.

2.03 DUCTWORK INSULATION MATERIALS

A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. CertainTeed Corp.; Duct Wrap.
    b. Johns Manville; Microlite EQ.
    c. Knauf Insulation; Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap B.
    e. Owens Corning; All-Service Duct Wrap.

B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.
    c. Johns Manville; 800 Series Spin-Glas.
    d. Knauf Insulation; Insulation Board.
    e. Manson Insulation Inc.; AK Board.
    f. Owens Corning; Fiberglas 700 Series.

2.04 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. Insulco, Division of MFS, Inc.; SmoothKote.
    b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    c. Rock Wool Manufacturing Company; Delta One Shot.

2.05 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. Aeroflex USA, Inc.; Aeroseal and Aeroseal LVOC.
    b. Armacell LCC; 520 Adhesive.
    c. Foster Products Corporation, H. B. Fuller Company; 85-75.

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. Childers Products, H.B. Fuller Company; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. Johns Manville Industrial Insulation; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. Dow Chemical Company (The); 739, Dow Silicone.
    b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.
    d. Red Devil, Inc.; Celulon Ultra Clear.
    e. Speedline Corporation; Speedline Vinyl Adhesive.

2.06 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Childers Products, H.B. Fuller Company; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. Johns Manville Industrial Insulation; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Childers Products, H.B. Fuller Company; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. Johns Manville Industrial Insulation; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.07 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Childers Products, H.B. Fuller Company; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Childers Products, H.B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.08 FACTORY-APPLIED JACKETS

A. Insulation systems indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PSK Jacket: Metalized polypropylene, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.09 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

D. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. Airex Manufacturing, Inc.; E-Flex Guard.
    b. Johns Manville; Zeston and Ceel-Co.
    c. P.I.C. Plastics, Inc.; FG Series.
    d. Proto PVC Corporation; LoSmoke.
    e. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated tank heads and tank side panels.

E. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. Airex Manufacturing, Inc.
    b. Johns Manville; Zeston and Ceel-Co.
    c. P.I.C. Plastics, Inc.; FG Series.
    d. Proto PVC Corporation; LoSmoke.
    e. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers:

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.

F. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Metal Jacketing Systems.
    b. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
    b. Finish and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
e. Factory-Fabricated Fitting Covers:

1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Sheet and roll stock ready for shop or field sizing factory cut and rolled to size.
b. Material, finish, and thickness are indicated in field-applied jacket systems.
c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
e. Factory-Fabricated Fitting Covers:

1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 728 Cold Seal ASJ or comparable products by one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. 3M Venture Tape.

2. Width: 3 inches.
3. Thickness: 9 mils.
4. Adhesion: 70 ounces force/inch in width.
5. Elongation: 3 percent.
6. Tensile Strength: 45 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with rubber or acrylic adhesive; complying with ASTM C 1136 and UL listed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 491 FSK or 791 Cold Seal Acrylic FSK, or comparable products by one of the following:

    a. Avery Dennison Corporation, Specialty Tapes Division.
    b. 3M Venture Tape.

2. Width: 3 inches.
3. Thickness: 6 mils.
4. Adhesion (Rubber Adhesive): 100 ounces force/inch in width.
5. Adhesion (Acrylic Adhesive): 90 ounces force/inch in width.
6. Elongation: 3 percent.
7. Tensile Strength: 35 lbf/inch in width.
8. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 370 White PVC tape, or comparable products by one of the following:

    a. Avery Dennison Corporation, Specialty Tapes Division.
    b. 3M Venture Tape.

2. Width: 2 inches.
3. Thickness: 5 mils.
4. Adhesion: 20 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 15 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 488 AWF rubber adhesive or 788 Cold Seal acrylic adhesive, or comparable products by one of the following:

    a. Avery Dennison Corporation, Specialty Tapes Division.
    b. 3M Venture Tape.

2. Width: 3 inches.
3. Thickness: 3.0 to 4.0 mils.
4. Adhesion (Rubber Adhesive): 90 ounces force/inch in width.
5. Adhesion (Acrylic Adhesive): 50 ounces force/inch in width.
6. Elongation: 3 percent.
7. Tensile Strength: 14 to 20 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the products specified.

    a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Pab-Bands and Fabstraps.
    b. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

    a. Products: Subject to compliance with requirements, provide one of the products specified.

        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; CD.
        3) Midwest Fasteners, Inc.; CD.
        4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

    a. Products: Subject to compliance with requirements, provide one of the products specified.

        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; Cupped Head Weld Pin.
        3) Midwest Fasteners, Inc.; Cupped Head.
        4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the products specified.

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the products specified.

1) GEMCO; Nylon Hangers.
2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the products specified.

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Products: Subject to compliance with requirements, provide one of the products specified.

        1) AGM Industries, Inc.; RC-150.
        2) GEMCO; R-150.
        3) Midwest Fasteners, Inc.; WA-150.
        4) Nelson Stud Welding; Speed Clips.

    b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Manufacturers:

        1) GEMCO.
        2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers:

    a. ACS Industries, Inc.
    b. C & F Wire.
    c. PABCO-Childers Metals; Johns Manville Industrial Insulation.
    d. RPR Products, Inc.

2.12 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive as recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. Seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install thermal hanger insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover thermal hanger inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the 4 o’clock or 8 o’clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer’s recommendations.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations that Are Not Fire Rated: Install insulation through walls and partitions as detailed.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations:

1. Terminate ductwork insulation at angle closure of fire damper sleeves.
2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.

    a. Firestopping is specified in Division 07 Section “Through-Penetration Firestop Systems.”

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
2. Pipe: Install insulation continuously through floor penetrations.

    a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for

above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible Elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.06 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:

    a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
    b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.

3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.08 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over compress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

3. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over compress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

C. Flexible Elastomeric Thermal Insulation Installation for Ducts and Plenums: Install insulation over entire surface of ducts and plenums.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.
3. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with strips of same material used to insulate duct and following manufacturer’s installation instructions.

3.09 FIELD-APPLIED JACKET INSTALLATION

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where self-adhesive jackets are indicated, install according to manufacturer’s instructions and details on the drawings. Overlap seams arranged to shed water.

F. Where sound barrier jackets are indicated, install in accordance with manufacturer’s instructions.

3.10 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

END OF SECTION 20 07 00

SECTION 21 11 00 - FIRE-SUPPRESSION SYSTEM

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Provisions of Division 20 Section “Mechanical General Requirements” apply to this Section.

C. Related Sections include the following:

1. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Hangers and Supports.”
4. Division 28 Section "Fire Alarm" for alarm devices not specified in this Section.

1.02 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.

C. PE: Polyethylene plastic.

D. Underground Service-Entrance Piping: Underground service piping below the building.

E. Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.

F. Hose Station: Hose connection, fire hose rack, and fire hose.

G. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

1.03 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.04 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. High-Pressure Piping System Component Working Pressure: Listed for 300 psig.

C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Fire-suppression standpipe system design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet shall be based on NFPA 14 and the requirements of the Owner:

a. Examples:

1) NPS 1-1/2 Hose Connections: 65 psig.
2) NPS 2-1/2 Hose Connections: 100 psig.

2. Unless otherwise indicated, the following is maximum residual pressure at required flow at each hose-connection outlet:

a. NPS 1-1/2 Hose Connections: 100 psig.
b. NPS 2-1/2 Hose Connections: 175 psig.

E. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications, for bidding purposes, as follows:

a. Automobile Parking Areas: Ordinary Hazard, Group 1.
b. Building Service Areas: Ordinary Hazard, Group 1.
c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
d. General Storage Areas: Ordinary Hazard, Group 1.
e. Machine Shops: Ordinary Hazard, Group 2.
f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
g. Office and Public Areas: Light Hazard.
h. Repair Garages: Ordinary Hazard, Group 2.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500-sq. ft. area.
d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm/sq. ft. over 2500-sq. ft. area.
e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm/sq. ft. over 2500-sq. ft. area.
f. Special Occupancy Hazard: As determined by authorities having jurisdiction.

4. Minimum Density for Deluge-Sprinkler Piping Design:

    a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over entire area.
    b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft over entire area.
    c. Extra-Hazard, Group 1 Occupancy: 0.30 gpm/sq. ft. over entire area.
    d. Extra-Hazard, Group 2 Occupancy: 0.40 gpm/sq. ft. over entire area.
    e. Special Occupancy Hazard: As determined by authorities having jurisdiction.

5. Maximum Protection Area per Sprinkler:

    a. Office Spaces: 120 sq. ft.
    b. Storage Areas: 130 sq. ft.
    c. Mechanical Equipment Rooms: 130 sq. ft.
    d. Electrical Equipment Rooms: 130 sq. ft.
    e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:

    a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
    c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

F. Water velocity in the piping system shall not exceed the following:

1. Underground mains: 16 ft./sec.
2. Aboveground mains: 32 ft./sec.
3. Sprinkler branch lines: 24 ft./sec.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.06 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

B. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.

2. Compressed air piping.
3. HVAC hydronic piping.
4. Items penetrating finished ceiling include the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.

D. Qualification Data: For qualified Installer.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, the Owner's insurance underwriter including hydraulic calculations, if applicable.

1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification number (SIN) or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

F. Fire-hydrant flow test report.

1.07 CLOSEOUT SUBMITTALS

A. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping"

B. Field quality-control reports.

C. Operation and Maintenance Data: For sprinkler specialties to include in operation and maintenance manuals.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. The provisions and requirements of the NFPA and the Owner's insurance underwriter constitute mandatory minimum requirements for the work of this Section.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
3. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
4. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
5. NFPA 230, "Fire Protection of Storage."

D. Grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1.09 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Coordinate with ceiling installer to ensure proper grid type and installation for use with flexible sprinkler drops.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, pressure class 350, with mechanical-joint bell end and plain end.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, pressure class 350, with push-on-joint bell end and plain end.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

2.03 STANDARD-WEIGHT BLACK STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends, and with factory applied antimicrobial coating on inner wall of pipe.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
5. Steel Threaded Couplings: ASTM A 865.

B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, and with factory applied antimicrobial coating on inner wall of pipe.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
2. Steel Flanges and Flanged Fittings: ASME B16.5.

2.04 BACKFLOW PREVENTION DEVICES

A. Double-Check, Detector-Assembly Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Conbraco Industries, Inc.
   b. FEBCO; a Division of Watts Water Technologies, Inc.
   c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
   d. Watts Water Technologies, Inc.; Watts Regulator Co.
   e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1048 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psi maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.

6. Body: Cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved.
7. End Connections: Flanged.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:

    a. Valves: Outside screw and yoke gate-type with flanged, or grooved ends on inlet and outlet.
    b. Bypass: With displacement-type water meter, shutoff valves, and double-check backflow prevention device.

B. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.
    b. FEBCO; a Division of Watts Water Technologies, Inc.
    c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
    d. Watts Water Technologies, Inc.; Watts Regulator Co.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1047 and Factory Mutual Global (FMG) approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved.
7. End Connections: Flanged.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:

    a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
    c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

2.05 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 300-psig working-pressure rating if fittings are components of high-pressure piping system.

B. Sprinkler Drain and Alarm Test Fittings: Cast-bronze or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

1. Manufacturers:

a. Tyco Fire Protection Products by Johnson Controls Company.
b. Fire-End and Croker Corp.
c. Viking Corp.
d. Victaulic Co. of America; Series UTD Universal Test and Drain.

C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

1. Manufacturers:

a. Elkhart Brass Mfg. Co., Inc.

D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

1. Manufacturers:

a. AGF Manufacturing Co.
b. G/J Innovations, Inc.
c. Triple R Specialty of Ajax, Inc.
d. Tyco Fire Protection Products by Johnson Controls Company.

E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

1. Manufacturers:

a. CECA, LLC.
b. Merit.

F. Flexible Sprinkler Drop Fittings:

1. Manufacturers:

a. Victaulic Co. of America; VicFlex Sprinkler Fittings; AH-2 or AH2-CC with AB1 Bracket Assembly.
b. Reliable Automatic Sprinkler Co., Inc.; RASCOflex Series RFB.
c. FlexHead Industries, Inc.; ASC Engineered Solutions

2. Description: UL listed and FMG approved stainless steel flexible hose for connection to sprinkler, and with bracket for connection to commercial ceiling grid.
3. Standard: UL 2443.
4. Pressure Rating: 175 psig minimum; 300 psig if fittings are components of high-pressure piping system.
5. Size: Same as connected piping, for sprinkler.

G. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

2.06 LISTED FIRE-PROTECTION VALVES

A. Valves: UL listed or FMG approved.

1. Valves shall have 175-psig minimum pressure rating.

B. Gate Valves with Wall Indicator Posts:

1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with operating wrench, extension rod, locking device, and cast-iron barrel.
3. Manufacturers:

a. McWane, Inc.; Kennedy Valve Div.
b. NIBCO.
c. Crane Co.; Crane Valve Group; Stockham Valves.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.

1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
3. NPS 3: Ductile-iron body with grooved ends.
4. Manufacturers:

a. NIBCO.
b. Victaulic Co. of America.

D. Butterfly Valves: UL 1091.

1. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.

a. Manufacturers:

1) McWane, Inc.; Kennedy Valve Div.
2) Mueller Company; ASC Engineered Solutions.
3) NIBCO.
4) Tyco Fire Protection Products by Johnson Controls Company.
5) Victaulic Co. of America; Series 705.

E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.

1. Manufacturers:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Valves.

d. Hammond Valve.
e. McWane, Inc.; Kennedy Valve Div.
f. Mueller Company; ASC Engineered Solutions.
g. NIBCO.
h. Tyco Fire Protection Products by Johnson Controls.
i. Victaulic Co. of America.
j. Watts Water Technologies, Inc.; Watts Regulator Co.

F. Gate Valves: UL 262, OS&Y type.

1. NPS 2 and Smaller: Bronze body with threaded ends.

a. Manufacturers:

1) Crane Co.; Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) NIBCO.

2. NPS 2-1/2 and Larger: Cast or ductile -iron body with flanged or grooved ends.

a. Manufacturers:

1) McWane, Inc.; Clow Valve Co.
2) Crane Co.; Crane Valve Group; Crane Valves.
3) Crane Co.; Crane Valve Group; Jenkins Valves.
4) Hammond Valve.
5) Milwaukee Valve Company.
6) Mueller Company.
7) NIBCO.
8) Victaulic Co. of America: Series 771.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.
2. NPS 2 and Smaller: Ball or butterfly valve with brass or bronze body and threaded ends.

a. Manufacturers:

1) Milwaukee Valve Company.
2) NIBCO.
3) Victaulic Co. of America; Series 728.

3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

a. Manufacturers:

1) Tyco Fire Protection Products by Johnson Controls.
2) McWane, Inc.; Kennedy Valve Div.

3) Milwaukee Valve Company.
4) NIBCO.
5) Victaulic Co. of America.

2.07 UNLISTED GENERAL-DUTY VALVES

A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.

B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.08 RISER MANIFOLD ASSEMBLIES

A. Contractor Option: Factory pre-assembled riser manifold assemblies may be used.

B. Available Sizes: NPS 1-1/4 to NPS 8.

C. Standard: UL listed and FMG approved.

D. Pressure Rating:

1. Standard-Pressure Valves: 175 psig minimum.
2. High-Pressure Valves: 300 psig.

E. Assembly Includes:

1. Pressure Gages: Listed an approved as specified in this Section.
2. Waterflow Alarm Switch: Listed and approved vane type waterflow detector.
3. Inspector's Test and Drain Valve: As specified under Sprinkler Specialty Fittings in this Section.

F. Manufacturers:

1. Victaulic Co. of America; Series UM Universal Manifold Assembly.
2. Viking Corp.; EasyPac Commercial Riser Assemblies.

2.09 ALARM CHECK VALVES

A. General Requirements:

1. Standard: UL listed or FMG approved.
2. Pressure Rating:

    a. Standard-Pressure Valves: 175 psig minimum.
    b. High-Pressure Valves: 300 psig.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Manufacturers:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire Protection Products by Johnson Controls Company.
3. Viking Corp.
4. Victaulic Co. of America.

C. Description: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.

1. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
2. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

2.10 AUTOMATIC (BALL DRIP) DRAIN VALVES

A. General:

1. Standard: UL 1726.
2. Pressure Rating: 175 psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

B. Manufacturer:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire Protection Products by Johnson Controls Company.

2.11 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 300-psig pressure rating if sprinklers are components of high-pressure piping system.

B. Manufacturers:

1. Reliable Automatic Sprinkler Co., Inc.

2. Tyco Fire Protection Products by Johnson Controls Company.
3. Victaulic Co. of America.
4. Viking Corp.

C. Automatic Sprinklers:

1. With heat-responsive glass bulb element complying with the following:

a. UL 199, for nonresidential applications.
b. UL 1767, for early-suppression, fast-response applications.
c. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
d. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for 165 deg F "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Extended-coverage sprinklers.
3. Flush ceiling sprinklers, including escutcheon.
4. Institution sprinklers, made with a small, breakaway projection.
5. Open sprinklers.
6. Pendent sprinklers.
7. Quick-response sprinklers.
8. Recessed sprinklers, including escutcheon.
9. Sidewall sprinklers.
10. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers. Escutcheons listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 3/4-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Sprinkler guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.12 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:

1. Elkhart Brass Mfg. Co., Inc.
2. Potter Roemer Fire Pro; A Member of Morris Group International.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."

1. Type: Exposed, projecting, with two inlets and round escutcheon plate.
2. Type: Flush, with two inlets and square or rectangular escutcheon plate.
3. Finish: Polished chrome-plated.

C. Exposed, Freestanding-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body, brass inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, and bottom outlet with pipe threads. Include brass lugged caps, gaskets, and brass chains; brass lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high, brass sleeve; and round, floor, brass escutcheon plate with marking "AUTO SPKR & STANDPIPE."

1. Finish Including Sleeve: Polished chrome-plated.

2.13 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

2.14 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge.
2. Ashcroft Inc.
3. Marsh Bellofram.
4. Viking Corp.
5. Weiss Instruments, Inc.

B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.

1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.

PART 3 EXECUTION

3.01 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.02 EARTHWORK

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.03 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 PIPING APPLICATIONS, GENERAL

A. Flanges, flanged fittings, unions, nipples, grooved-joint couplings, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints; or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

C. Underground Service-Entrance Piping: Ductile-iron, push-on or mechanical-joint pipe and fittings and restrained joints.

3.05 SPRINKLER RISER AND STANDPIPE SYSTEM PIPING APPLICATIONS

A. Sprinkler Risers and Standpipes: Use the following:

Pipe Type	4” & Smaller	5” & 6”	8” - 12”
Standard weight steel, threaded fittings	YES	YES	NO
Standard weight steel, grooved fittings	YES	YES	YES
Standard weight steel, welded fittings	YES	YES	YES

3.06 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Wet-Pipe Sprinklers: Use the following:

Pipe Type	1 ½" & Smaller	2"	2 ½" – 3 ½"	4"	5" – 6"
Standard weight steel, threaded fittings	YES	YES	YES	YES	NO
Standard weight steel, grooved fittings	NO	NO	YES	YES	YES
Standard weight steel, welded fittings	NO	YES	YES	YES	YES

3.07 VALVE APPLICATIONS

A. The following requirements apply:

1. Listed Fire-Protection Valves: UL listed or FMG approved for applications where required by NFPA 13.

   a. Shutoff Duty: Use ball, butterfly, or gate valves.

2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.

   a. Shutoff Duty: Use ball, butterfly, or gate valves.
   b. Throttling Duty: Use ball or globe valves.

3.08 JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

C. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

D. Use of saddle style tees is not acceptable.

E. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.

F. Mechanically Formed, Copper-Tube-Outlet Joints: Use UL-listed tool and procedure. Drill pilot hole in copper tube, form branch for collar, dimple tube to form seating stop, and braze branch tube into formed-collar outlet.

G. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. All grooved couplings, fittings, gaskets, valves, and specialties shall be the product of a single manufacturer.
2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

H. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Division 20 Section “Basic Mechanical Materials and Methods” for additional requirements.

3.09 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 33 Section "Water Distribution" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.10 PIPING INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install drain valves on standpipes.

J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

K. Install alarm devices in piping systems.

L. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install standpipe system piping according to NFPA 14.
2. Install sprinkler system piping according to NFPA 13, except use of “C” clamps, or beam clamps of “C” pattern, or any modification thereof, is prohibited for supporting pipes larger than NPS 2-1/2.
3. Refer to Division 20 Section “Hangers and Supports” for additional requirements.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Drain dry-type standpipe piping.

O. Drain dry-pipe sprinkler piping.

P. Fill wet-standpipe system piping with water.

Q. Fill wet-pipe sprinkler system piping with water.

3.11 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.

D. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

E. Specialty Valves:

1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

    a. Air-Pressure Maintenance Devices for Dry-Pipe Systems: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
    b. Install air compressor and compressed-air supply piping.

3. Deluge Valves: Install in vertical position, in proper direction of flow, in main supply to deluge system.

3.12 SPRINKLER APPLICATIONS

A. Use the following sprinkler types:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Sprinkler Finishes:

    a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes; white polyester finish in natatoriums.
    b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
    c. Flush Sprinklers: Bright chrome, with painted white escutcheon.
    d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
    e. Residential Sprinklers: Dull chrome.

5. Sprinkler Guards: For exposed sprinkler heads subject to damage.

3.13 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

C. Install sprinklers into flexible sprinkler drop fittings and install into bracket on ceiling grid. Install according to manufacturer's instructions and NFPA, State, and local guidelines. Ceiling grid must meet requirements of ASTM C 635 and C 636, coordinate with ceiling installer.

3.14 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire department connections in vertical wall.

B. Install freestanding-type, fire department connections in level surface.

1. Install protective pipe bollards on two sides of each fire department connection. Refer to Division 05 Section "Metal Fabrications" for pipe bollards.

C. Install ball drip valve at each check valve for fire department connection.

3.15 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.

C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

E. Electrical Connections: Power wiring and fire alarm wiring are specified in Division 26.

F. Connect alarm devices to fire alarm.

G. Ground equipment according to Division 26 Section "Grounding and Bonding."

H. Connect wiring according to Division 26 Section "Conductors and Cables."

I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.16 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 20 Section "Mechanical Identification."

3.17 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
5. Verify that equipment hose threads are same as local fire department equipment.
6. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.

B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

C. Verify that excess-pressure pumps and accessories are installed and operate correctly.

D. Verify that air compressors and their accessories are installed and operate correctly.

E. Verify that specified tests of piping are complete.

F. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

G. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

H. Verify that potable-water supplies have correct types of backflow preventers.

I. Pressurize and check dry-pipe sprinkler piping air-pressure maintenance devices and air compressors.

J. Verify that hose connections are correct type and size.

K. Verify that hose stations are correct type and size.

L. Energize circuits to electrical equipment and devices.

M. Start and run excess-pressure pumps.

N. Start and run air compressors.

O. Adjust operating controls and pressure settings.

P. Coordinate with fire alarm tests. Operate as required.

Q. Coordinate with fire-pump tests. Operate as required.

R. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.18 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.19 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION 21 11 00

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1.02 SUMMARY

A. This Section includes valves for general plumbing applications. Refer to piping Sections for specialty valve applications.

1.03 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.

4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.
9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.05 QUALITY ASSURANCE

A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 VALVES, GENERAL

A. Isolation valves are scheduled on the Drawings. For other general plumbing valve applications, use the following:

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

D. For valves not indicated in the Application Schedules, select valves with the following end connections:

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless otherwise noted.

F. Wetted surfaces of valves contacted by consumable water shall contain not more than 0.25 percent weighted average lead content.

G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

H. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

I. Extended Valve Stems: On insulated valves.

J. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

K. Valve Grooved Ends: AWWA C606.

L. Solder Joint: With sockets according to ASME B16.18.

1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

M. Threaded: With threads according to ASME B1.20.1.

N. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Series 70LF-140/240.
b. Hammond Valve.
c. Kitz Corporation; Kitz Valves.
d. Milwaukee Valve Company; Model UPBA100S/150S.
e. NIBCO INC.; Models S-580-70-66-LF/T-580-70-66-LF.
f. Watts Water Technologies, Inc.

C. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Series 77CLF-A Series.
b. Hammond Valve.
c. Kitz Corporation; Kitz Valves.
d. Milwaukee Valve Company; UPBA400S/450S.
e. NIBCO INC.; Models S-585-70-66-LF/T-585-70-66-LF.
f. Watts Water Technologies, Inc.; Series LFB6080G2/LFB6081G2.

2.03 GENERAL SERVICE BUTTERFLY VALVES

A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:

1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.

B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
    b. Bray International, Inc.
    c. DeZurik.
    d. Emerson Automation Solutions; Keystone.
    e. Forum Energy Technologies; ABZ Valve.
    f. Hammond Valve.
    g. Milwaukee Valve Company.
    h. NIBCO INC.; LD-2000-3/5.
    i. Tyco Flow Control; Grinnell Flow Control.
    j. Watts Water Technologies.

2.04 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 125, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; by Conbraco Industries, Inc.; Model 162T-LF and 163T-LF (61YLF Series).
    b. Milwaukee Valve Company; Model UP509/UP1509.
    c. NIBCO INC.; Models S-413-B-LF or T-413-B-LF.
    d. Watts Water Technologies; LFCVY/LFCVYS.

2.05 IRON SWING CHECK VALVES

A. Iron Swing Check Valves, General: MSS SP-71.

B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; by Conbraco Industries, Inc.; Model 910F.
    b. Crane Co.; Crane Valves.
    c. Crane Co.; Stockham Div.
    d. Hammond Valve; IR1124-HI.
    e. Milwaukee Valve Company; Model F-2974.

f. NIBCO INC.; Model F-918-B.
g. Watts Water Technologies.

C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Model 920F.
b. Crane Co.; Crane Valves.
c. Crane Co.; Stockham Div.
d. Hammond Valve; IR322.
e. Milwaukee Valve Company; Model F-2970.
f. NIBCO INC.; Model F-968-B.
g. Watts Water Technologies.

D. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; nonasbestos, synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mueller Co.
b. NIBCO, INC.; Model G-917-W.
c. Victaulic Co. of America.

2.06 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Bronze ball valve as specified in this Section. Lead free construction is not required.
2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
3. Standard: MSS SP-80 for gate valves.
4. Pressure Rating: Class 125.
5. Size: NPS 3/4.
6. Body: ASTM B 62 bronze.
7. Inlet: NPS 3/4 threaded or solder joint.
8. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.07 SOURCE QUALITY CONTROL

A. Identification: Factory label or color coding to identify lead free valves.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.03 JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.04 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 05 23

SECTION 22 11 16 - DOMESTIC WATER PIPING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods” for materials and methods common to mechanical piping systems.
3. Division 20 Section “Hangers and Supports.”
4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
5. Division 22 Section “General-Duty Valves for Plumbing.”

6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.02 SUMMARY

A. This Section includes domestic water piping inside the building.

1.03 DEFINITIONS

A. PEX: Crosslinked polyethylene plastic.

1.04 PERFORMANCE REQUIREMENTS

A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1. Exception: PEX plastic piping insert fittings specified are limited to 100 psig.

1.05 SYSTEMS DESCRIPTION

A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.

1.06 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.07 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.
2. Domestic water piping.
3. Compressed air piping.
4. HVAC hydronic piping.

1.08 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

1.09 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

E. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

1.10 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner's written permission.

1.11 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.03 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Grooved-Joint Systems:

1. Manufacturers:

    a. ASC Engineered Solutions; Gruvlok; Fig. 64 CTS SlideLOK.
    b. Victaulic Company; Style 606 and Style 607.

2. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
3. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

D. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Viega North America; ProPress System.
    b. NIBCO Inc.; Press System.
    c. Mueller Industries, Inc.; Streamline PRS.
    d. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
    e. Apollo Valves; by Conbraco Industries; ApolloXpress.

f. ASC Engineered Solutions; Anvil Press.

2. Housing: Copper.
3. O-Rings and Pipe Stops: EPDM.
4. Tools: Manufacturer's special tools.
5. Maximum 200-psig working-pressure rating at 250 deg F.

E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. T-DRILL Industries Inc.

2.04 VALVES

A. General-duty plumbing valves; and drain valves are specified in Division 22 Section "Plumbing Valves."

B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

2.05 SPECIALTY VALVES

A. Bronze Gate Valves: MSS SP-80, with malleable-iron handwheel.

1. Class 150, Rising-Stem, Bronze Gate Valves: ASTM B-62 bronze body, bonnet, and wedge, copper-silicone bronze stem, screw-in bonnet, threaded end connections; and having 300 psig CWP rating.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) Milwaukee Valve Company; Model 1150.
4) NIBCO INC.; Models T-131, S-134 or T-134.
5) Watts Water Technologies, Inc.; Series B-3110.

B. Cast-Iron Gate Valves: MSS SP-70, with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.

1. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim, and solid-wedge disc; and having 200 psig CWP rating.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) Milwaukee Valve Company; Model F-2885.
4) NIBCO INC.; Model F-617-O.
5) Watts Water Technologies.

PART 3 EXECUTION

3.01 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.02 PIPING SYSTEM INSTALLATION

A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 20 Section "Meters and Gages," and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."

E. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.

F. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

G. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

H. Install domestic water piping level without pitch and plumb.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. PEX Piping Joints: Join according to ASTM F 1807.

3.04 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 20 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

F. Install supports for vertical steel piping every 15 feet.

G. Install hangers for drawn-temper copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60-inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Soft copper tube: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

J. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

K. Install hangers for Schedule 10 stainless steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.
2. NPS 2-1/2: 84 inches with 1/2-inch rod.
3. NPS 3: 96 inches with 1/2-inch rod.
4. NPS 4: 10 feet with 5/8-inch rod.
5. NPS 6: 11 feet with 3/4-inch rod.
6. NPS 8: 12 feet with 7/8-inch rod.
7. NPS 10 to NPS 12: 14 feet with 7/8-inch rod.

L. Install supports for vertical Schedule 10 stainless steel piping every 15 feet.

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.05 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic water piping to distribution side of water meter with shutoff valve.

C. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 20 Section “Basic Mechanical Materials and Methods” for dielectric fittings.

D. Install piping adjacent to equipment and machines to allow service and maintenance.

E. Connect domestic water piping to the following:

1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."

2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
3. Booster Pumps: Cold-water suction and discharge piping.
4. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3.06 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.07 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.08 CLEANING AND DISINFECTION

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
4. Division 22 Section "Domestic Water Piping " for water meters.
5. Division 22 Section "Drinking Fountains, Water Coolers and Cuspidors" for water filters for water coolers.

1.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Flow Reports and Settings: For calibrated balancing valves.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
3. Comply with NSF 372, “Drinking Water System Components – Lead Content” for components with wetted surfaces in contact with potable water.

PART 2 PRODUCTS

2.01 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.
b. FEBCO; a Division of Watts Water Technologies, Inc.
c. Watts Water Technologies, Inc.; Watts Regulator Co.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. MIFAB, Inc.
    c. Watts Water Technologies, Inc.; Watts Regulator Co.
    d. Woodford Manufacturing Company.

2. Standard: ASSE 1011.
3. Body: Bronze or brass, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. FEBCO; a Division of Watts Water Technologies, Inc.
    c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
    d. Watts Water Technologies, Inc.; Watts Regulator Co.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size and Capacity: As indicated on the drawings.
6. Accessories:

    a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. Watts Water Technologies, Inc.; Watts Regulator Co.

2. Standard: ASSE 1056.

3. Operation: Continuous-pressure applications.
4. Size: As indicated on the drawings.
5. Accessories:

    a. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. FEBCO; a Division of Watts Water Technologies, Inc.
    c. Watts Water Technologies, Inc.; Watts Regulator Co.
    d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 3/4.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. FEBCO; a Division of Watts Water Technologies, Inc.
    c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
    d. Watts Water Technologies, Inc.; Watts Regulator Co.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
c. Y-Pattern strainer and soft-seated check valve.

C. Double-Check Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.
b. FEBCO; a Division of Watts Water Technologies, Inc.
c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
d. Watts Water Technologies, Inc.; Watts Regulator Co.
e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

D. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.
b. FEBCO; a Division of Watts Water Technologies, Inc.
c. Watts Water Technologies, Inc.; Watts Regulator Co.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Size: As indicated on the drawings.
5. Body: Bronze with union inlet.

E. Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.
b. Watts Water Technologies, Inc.; Watts Regulator Co.

c. Woodford Manufacturing Company.

2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.03 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers:

a. Apollo Valves; Conbraco Industries, Inc.
b. Keckley Company.
c. Metraflex Company.
d. Mueller Steam Specialty; a Watts Brand.
e. NIBCO, Inc.
f. Titan Flow Control, Inc.
g. Watts.
h. Yarway; Emerson Automation Solutions.

2. CWP: 200 psig minimum, unless otherwise indicated.
3. SWP: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
5. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Screen: Stainless steel with round perforations, unless otherwise indicated.
7. Perforation Size:

a. Strainers NPS 2 and Smaller: 0.033 inch.
b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
c. Strainers NPS 5 and Larger: 0.045 inch.

8. Drain: Pipe plug.

2.04 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.05 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Water Technologies, Inc.; Watts Regulator co.
    f. Woodford Manufacturing Company.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze or chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Rough bronze.
12. Operating Keys(s): One with each wall hydrant.

2.06 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. MIFAB, Inc.
    b. PPP Inc.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Watts Water Technologies, Inc.; Watts Regulator Co.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

B. Water Hammer Arresters (Metal Bellows Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Josam Company.
    c. MIFAB, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Precharged stainless steel bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.07 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.

4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.
4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install shutoff valve on outlet if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

J. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

K. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.

L. Install non-freeze, nondraining-type post hydrants set in concrete or pavement.

M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.

N. Install roof hydrants in accordance with manufacturer's instructions. Pipe drain hole to acceptable discharge point.

O. Install water hammer arresters in water piping according to PDI-WH 201.

P. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

Q. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

R. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

S. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.

3. Reduced-pressure-principle backflow preventers.
4. Double-check backflow-prevention assemblies.
5. Carbonated-beverage-machine backflow preventers.
6. Dual-check-valve backflow preventers.
7. Water pressure-reducing valves.
8. Calibrated balancing valves.
9. Primary, thermostatic, water mixing valves.
10. Manifold, thermostatic, water-mixing-valve assemblies.
11. Photographic-process, thermostatic, water-mixing-valve assemblies.
12. Primary water tempering valves.
13. Outlet boxes.
14. Hose stations.
15. Supply-type, trap-seal primer valves.
16. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves as follows:

1. Set calibrated balancing valves at calculated presettings.
2. Measure flow each station and adjust where necessary.
3. Record settings and mark balancing devices.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 11 19

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements”.
2. Division 20 Section “Basic Mechanical Materials and Methods”.
3. Division 22 Section “Drainage Piping Specialties”.
4. Division 22 Section "Chemical-Waste Piping" for chemical-waste and vent piping systems.
5. Division 22 Section "Sewage Pumps."
6. Division 22 Section “Sanitary Waste and Vent Piping” for piping outside building.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Sanitary Sewer, Force-Main Piping: 125 psig.

1.04 SYSTEMS DESCRIPTIONS

A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

1.05 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.06 CLOSEOUT SUBMITTALS

A. Field quality-control inspection and test reports.

1.07 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).

C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping;

"NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

1.08 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers:

a. ANACO-Husky; McWane Plumbing Group.
b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
c. IDEAL-TRIDON.
d. MIFAB, Inc.
e. Mission Rubber Company; a division of MCP Industries, Inc.
f. Tyler Pipe; McWane Plumbing Group.

2. Standards: CISPI 310.
3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:

    a. ANACO-Husky; McWane Plumbing Group; SD 4000.
    b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
    c. IDEAL-TRIDON; Heavy-Duty “HD” No-Hub Couplings.
    d. Norma Group; Clamp-All Products; HI-TORQ 125.

2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

A. Hard Copper Tube: ASTM B 88, Types M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.04 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.05 SPECIALTY PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. ANACO.

D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.; DMD Div.
c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
d. JCM Industries, Inc.
e. Smith-Blair, Inc.

f. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

a. SIGMA Corp.

PART 3 EXECUTION

3.01 EXCAVATION

A. Comply with requirements in Division 31 Section “Earth Moving” for excavating, trenching, and backfilling.

3.02 PIPING SYSTEM INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Sanitary sewer piping outside the building is specified in Division 22 Section "Sanitary Sewerage."

C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

F. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

G. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to

make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

H. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drainpipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.

L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

M. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

N. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

1. Trace Wire: Yellow insulated, minimum 18 AWG wire, having copper or other approved conductor, with insulation suitable for direct burial, installed adjacent to underground nonmetallic piping, with aboveground access to tracer wire at each end of pipe.

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

    a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
    b. NPS 2 and Larger: Pressure transition couplings.

3.05 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 20 Section "Valves."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Backwater valves are specified in Division 22 Section "Drainage Piping Specialties."

3.06 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main or sanitary manhole.
2. Sewage Pumps: To sewage pump discharge.

3.08 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

3.09 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 13 16

SECTION 22 13 19 - DRAINAGE PIPING SPECIALTIES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section "Plumbing Fixtures" for hair interceptors.
4. Division 22 Section "Healthcare Plumbing Fixtures" for plaster sink interceptors.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PUR: Polyurethane plastic.

H. PVC: Polyvinyl chloride plastic.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings:

B. Delegated-Design Submittal: For siphonic roof drainage system indicated to comply with performance requirements and design criteria, including analysis data.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.01 CAST-IRON CLEANOUTS

A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.

B. Exposed Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.; Series 58910.
    b. MIFAB, Inc.; C1460.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; 4510 Series.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.

C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.; C1220-R.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.

5. Clamping Device: Not required.
6. Outlet Connection: Spigot.
7. Closure: Brass, bronze, or plastic plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads, set screws or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to clean out.

D. Cast–Iron Floor Cleanouts (Not-On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.; C-1100-C-R-34.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4333C.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Spigot.
7. Closure: Brass, bronze, or plastic plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads, set screws or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to clean out.

E. Cast-Iron Wall Cleanouts (Finished Wall Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.; Model 58790-20.
    b. MIFAB,Inc.; C1460-RD.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.

3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains (Toilet Rooms, Labs, and Janitor's Closet) FD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom unless otherwise noted.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round, with vandal proof screws.
12. Dimensions of Top or Strainer: 7 inch diameter.
13. Top Loading Classification: Light Duty.
14. Inlet Fitting: Gray iron, with spigot outlet.

B. Cast-Iron Floor Drains (Mechanical Rooms, Electrical Rooms, and Penthouses) FD-3:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2142.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.7.

3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom unless otherwise noted.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Sediment Bucket: 3-3/4 inches deep, slotted sediment bucket with lift bar.
10. Top or Strainer Material: Cast-iron.
11. Top Shape: Round.
12. Dimensions of Top or Strainer: 11-1/2 inch diameter tractor grate, 29 square inches of free area. Provide partial grate where required to accept equipment drains.
13. Top Loading Classification: Heavy Duty.
14. Outlet Fitting: Gray iron, with spigot outlet.

C. Large Capacity Floor Drains FD-6:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2450-SSB.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Fabricated steel.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Galvanized coating.
9. Sediment Bucket: Perforated stainless steel sediment bucket with lift bar.
10. Top or Strainer Material: Cast iron.
11. Top of Body and Strainer Finish: Gray iron.
12. Top Shape: Rectangular.
13. Dimensions of Top or Strainer: 12-3/4 inch by 10-3/4 inch.
14. Top Loading Classification: Heavy Duty.
15. Outlet Connection: Spigot outlet.

2.03 FLOOR SINKS

A. Stainless-Steel Floor Sink Drains FS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 3006-12.
d. Tyler Pipe; Wade Div.
e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.7.
3. Outlet: Bottom unless otherwise noted.
4. Top or Strainer Material: Stainless steel.
5. Top Shape: Square.
6. Dimensions of Top or Strainer: 12 inch by 12 inch, 14 gage, Type 304 stainless steel ribbed, non-tilt loose set half grate with 1/2 inch square holes and perforated stainless steel sediment bucket.
7. Seepage Flange: Required.
8. Clamping Device: Required.

2.04 TRENCH DRAINS

A. Modular Cast-Iron Trench Drains: TD-1

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 9872 Series.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3 for trench drains.
3. Material: Polyester Fiberglass channel.
4. Flange: Anchor.
5. Clamping Device: Not required.
6. Outlet: Bottom unless otherwise indicated.
7. Grate Material: Ductile iron.
8. Grate Finish: Not required.
9. Dimensions of Frame and Grate: 8 inches wide, and length indicated on Drawings.
10. Top Loading Classification: Heavy Duty.
11. Extension Sections: As required to suit project.

2.05 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ayrlett, LLC.
b. Durgo, Inc.
c. Oatey.
d. ProSet Systems Inc.
e. RectorSeal.
f. Studor, Inc.

2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Durgo, Inc.
b. Oatey.
c. Studor, Inc.

2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

C. Wall Box:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Durgo, Inc.
b. Oatey.
c. RectorSeal.
d. Studor, Inc.

2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.06 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company; Elmdor/Stoneman Div.

b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 8 inches from pipe, with boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.07 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.

2. Standard: ASSE 1072-2007.
3. Sealing Element: Neoprene rubber or chemically resistant elastomer.
4. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.08 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Hub Outlets:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

a. NPS 2: 4-inch- minimum water seal.
b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.

3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend [**1 inch**] [**2 inches**] above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.09 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.10 OIL SEPARATORS

A. Oil Interceptors: OI-1

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Highland Tank & Manufacturing Co., Inc.
    b. Josam Company; Josam Div.
    c. MIFAB, Inc.
    d. Rockford Sanitary Systems, Inc.
    e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    f. Striem; Model OS-100.
    g. Tyler Pipe; Wade Div.
    h. Watts Drainage Products Inc.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Type: Factory-fabricated interceptor for separating and removing light oil from wastewater.
3. Body Material: Cast iron, steel, or polypropylene.
4. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
5. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
6. Size and Capacities: As indicated on the drawings.
7. Cleanout: Integral or field installed on outlet.
8. Mounting: Recessed, flush with floor.
9. Oil Storage Tank: Coordinate with Division 33 Section "Fuel Oil Distribution."

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

1. Installation of Access Hand Holes:

a. Install boxes level and plumb and with orientation and depth coordinated with connecting piping to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of piping, and seal joint between box and extension as recommended by the manufacturer.
b. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

H. Assemble stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

I. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

J. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

K. Install fixture air-admittance valves on fixture drain piping.

L. Install stack air-admittance valves at top of stack vent and vent stack piping.

M. Install air-admittance-valve wall boxes recessed in wall.

N. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

O. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

P. Assemble open drain fittings and install with top of hub 2 inches above floor.

Q. Install deep-seal traps on floor drains and other waste outlets, if indicated.

R. Install floor-drain, trap-seal primer fittings on floor drains that require trap-seal primer connection.

S. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

T. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

U. Install vent caps on each vent pipe passing through roof.

V. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

W. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

X. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

Y. Assemble components of FOG disposal systems and install on floor. Install trap, vent, fresh-air inlet, and flow-control fitting according to authorities having jurisdiction. Install shelf fastened to reinforcement in wall construction and adjacent to unit, unless otherwise indicated. Install culture bottle, culture metering pump, timer, and control on shelf. Install tubing between culture bottle, metering pump, and chamber.

Z. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

AA. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction. Install control panel adjacent to unit, unless otherwise indicated.

BB. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Division 33 Section "Fuel Oil Distribution."

CC. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

DD. Install wood-blocking reinforcement for wall-mounting-type specialties.

EE. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

FF. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

GG. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. FOG Disposal Systems: Connect inlet and outlet to unit, connect flow-control fitting and fresh-air inlet piping to unit inlet piping, and connect vent piping between trap and media chamber. Connect electrical power.

D. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

E. Grease Removal Devices: Connect controls, electrical power, factory-furnished accessories, and inlet, outlet, and vent piping to unit.

F. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

G. Ground equipment according to Division 26 Section "Grounding and Bonding."

H. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Solids interceptors.
2. Oil interceptors.
3. Grease interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.05 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 22 14 29 - SUMP PUMPS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section “Sewage Pumps” for applications in sanitary drainage systems.

1.2 SUMMARY

A. This Section includes sump pumps and accessories, inside the building, for building storm drainage systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of sump pump specified, include certified performance curves with operating points plotted on curves, rated capacities of selected models, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each sump pump to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sump pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate size and location of concrete basins. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SUBMERSIBLE SUMP PUMPS

A. Manufacturers:

1. ABS Pumps, Inc.
2. Bell & Gossett; Xylem Inc.
3. Crane Pumps and Systems; Barnes.

4. EBARA International Corporation; Standard Pump Division.
5. Goulds Pumps; Xylem Inc.
6. Gorman-Rupp Company (The).
7. Grundfos Pumps Corporation.
8. Hydromatic.
9. Little Giant Pump Co.
10. Metropolitan Industries, Inc.
11. Weil Pump Company, Inc.
12. Zoeller Company.

B. Description: Factory-assembled and -tested, quick-disconnect, duplex, single-stage, centrifugal, end-suction, submersible, direct-connected sump pumps complying with UL 778 and Hydraulic Institute HI 1.1-1.2 and HI 1.3 for submersible sump pumps.

C. Casing: Cast iron; with cast-iron inlet strainer, legs that elevate pump to permit flow into impeller, and vertical discharge with companion flange for piping connection.

D. Casing: Stainless steel; with stainless-steel inlet strainer, legs that elevate pump to permit flow into impeller, and vertical discharge with companion flange suitable for piping connection.

E. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, semi-open non-clog design, overhung, single suction, keyed and secured to shaft.

F. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings and double-mechanical seals.

G. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; three-conductor waterproof power cable of length required, and with grounding plug and cable-sealing assembly for connection at pump. Comply with requirements in Division 20 Section "Motors."

1. Moisture-Sensing Probe: Internal moisture sensor with moisture alarm.

H. Pump Discharge Piping: Factory or field fabricated. Refer to Division 22 Section “Storm Drainage Piping.”

I. Basin Cover: Cast iron or steel with bituminous coating and strong enough to support controls. See Part 2 "Sump Pump Basins. Article for other requirements.

J. Controls:

1. Mount controls in NEMA 250, Type 4X enclosure. Controls shall include: Fused disconnect switches and combination magnetic starters with overload protection for each phase to protect against single phasing. Three phase units shall include control transformer and control circuit fuse.

a. Minimum SCCR according to UL 508 shall be as indicated on the Drawings or 10,000 A, whichever is greater.

2. Furnish an automatic alternator with manual on-off switch to change sequence of pump operation on the completion of each pump cycle.

    a. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:

        1) NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.

3. Mount three position, hand-off-auto, selector switches and magnetic starter manual reset push-buttons on the control panel door for manual operation and resetting of the magnetic starters.
4. Station shall be furnished with four, single pole, normally open NON-mercury mechanical float switches with 20 ft. cords, clamps, cord grips, and fasteners for pump off/lead pump on/lag pump on/high-water-alarm operation. The high-water-alarm switch shall be mounted as indicated on the Drawings. System shall be complete with cover mounting bracket. (1-inch diameter support pole by Contractor.)
5. Provide high water alarm switch, complete with actuating mechanism for operation on an electric circuit other than the motor circuit. The switch shall be designed to operate indicated alarm device(s) and one set of spare contacts whenever a predetermined high-water level is reached in the sump. Provide alarm pilot light and alarm bell with silence switch. Mount controls on pedestal on the sump cover plate.

K. Guiderail Supports: Include the following for each sump pump:

1. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
2. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
3. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
4. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
5. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
6. Lifting Cable: Stainless Steel; attached to pump and cover at manhole.

2.3 SUMP PUMP BASINS

A. Manufacturer: Sump pump and basin are to be provided by the same manufacturer.

B. Description: Factory fabricated basin with sump, pipe connections, and separate cover.

C. Sump: Fabricate watertight, with sidewall openings for pipe connections.

1. Material: Fiberglass.
2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
3. Anchor Flange: Same material as or compatible with sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

D. Cover: Fabricate with openings having gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Material: Cast iron or steel.
2. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

E. Capacity and Characteristics:

1. Refer to Drawings for capacity and characteristics.

2.4 BUILDING AUTOMATION SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 CONCRETE

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 20 Section "Basic Mechanical Materials and Methods."

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 SUMP PUMP INSTALLATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

B. Install sump pumps according to applicable requirements in Hydraulic Institute HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible sump pumps on basin floor. Make direct connections to storm drainage piping.

E. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.

F. Construct sump pump pits and connect to drainage piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.

G. Install packaged, submersible, drainage pump unit basins on floor or concrete base unless recessed installation is indicated. Make direct connections to storm drainage piping.

H. Support piping so weight of piping is not supported by pumps.

3.4 CONNECTIONS

A. Piping installation requirements are specified in Division 22 Section "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to sump pumps to allow service and maintenance.

C. Connect storm drainage piping to pumps. Install discharge piping equal to pump discharge connection size. If pump discharge connection size is different from storm drainage piping size, provide transition from pump discharge piping size to storm drainage piping size. Refer to Division 22 Section “Storm Drainage Piping.”

1. Install flexible connectors adjacent to pumps in discharge piping.
2. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 20 Section "Valves" for general-duty valves for drainage piping.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Disconnect couplings and check motors for proper direction of rotation.
4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

B. Start pumps without exceeding safe motor power:

1. Start motors.
2. Open discharge valves slowly.
3. Check general mechanical operation of pumps and motors.

C. Test and adjust controls and safeties.

D. Remove and replace damaged and malfunctioning components.

1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION 22 14 29

SECTION 22 15 13 - GENERAL-SERVICE COMPRESSED-AIR PIPING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Meters and Gages" for thermometers and pressure gages.
4. Division 22 Section "General-Service Compressed-Air Equipment" for compressed-air equipment and accessories.

1.02 SUMMARY

A. This Section includes piping and related specialties for general-service (shop) compressed-air systems operating at 200 psig and less.

1.03 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.

C. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 125 psig and less.

D. NBR: Acrylonitrile-butadiene rubber.

1.04 SYSTEMS DESCRIPTIONS

A. Low-Pressure Compressed-Air Piping between Air Compressors and Receivers: Use the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.
2. NPS 2-1/2 and Larger: Schedule 40, black-steel pipe; flanged.

B. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.
2. NPS 2-1/2 and Larger: Schedule 40, black-steel pipe; flanged.

C. Valves:

1. Refer to Division 20 Section "Valves" for general duty valves for compressed air service. Use metal valves, unless otherwise indicated.
2. Equipment Isolation NPS 2 and Smaller: Safety-exhaust ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:

1. Pipes, tubes, and fittings.
2. Safety valves.
3. Pressure regulators.
4. Filters.

5. Automatic drain valves.
6. Quick couplings.
7. Hose assemblies.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For general-service compressed-air systems. Include relationship to other services that serve same work area.

1.07 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

1.08 QUALITY ASSURANCE

A. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.09 PROJECT CONDITIONS

A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of compressed-air service.
2. Do not proceed with interruption of compressed-air service without Owner's written permission.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Refer to Part 1 "Systems Descriptions" Article for applications of pipe, tube, fittings, valves, and joining materials.

2.02 PIPES, TUBES, AND FITTINGS

A. Black, Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.

3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
4. Wrought-Steel Fittings: ASME B16.9, Schedule 40, butt welding.
5. Forged-Steel Fittings: ASME B16.11, socket type.
6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

C. Flexible Pipe Connectors: Refer to Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”

2.03 JOINING MATERIALS

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for joining materials not in this Section.

2.04 VALVES

A. General Duty Valves: Comply with requirements specified in Division 20 Section "Valves."

2.05 SPECIALTY VALVES

A. Safety-Exhaust, Bronze Ball Valves: Two-piece bronze stem and chrome-plated bronze ball, having exhaust vent opening for pneumatic applications, locking handle, threaded ends, and 600-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.; Apollo Div.; 7K-100-27.
    b. DynaQuip Controls.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO INC.; Model T-585-70-SV.
    f. Watts Water Technologies, Inc.

2.06 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Emerson Process Management; Fisher Controls.
    b. IMI Norgren.
    c. Parker-Hannifin Corporation.

2. Type: Pilot operated.

C. Air-Line Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Emerson Process Management; Fisher Controls.
    b. IMI Norgren.
    c. Parker-Hannifin Corporation.

2. Type: Diaphragm or pilot operated.

D. Air-Line Pressure Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Emerson Process Management; Fisher Controls.
    b. IMI Norgren; Excelon Plus Modular System Pressure Regulators.
    c. Parker-Hannifin Corporation.

2. Aluminum alloy or plastic body, diaphragm operated, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
3. Outlet pressure adjustable from 4 to 45 psig.
4. Push-to-lock adjusting knob with tamper resistant feature.

E. Air-Line Lubricators: Sizes and capacities indicated; equip with drip chamber and sight dome for observing oil drop entering airstream; with oil-feed adjustment screw and quick-release collar for easy bowl removal.

1. Provide with automatic feed device for supplying oil to lubricator.

F. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters in sizes and ratings indicated. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock.

G. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded.

H. Automatic Drain Valves: Corrosion-resistant metal body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

I. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroquip by Eaton.
b. Hansen Coupling by Eaton.
c. Parker Hannifin Corporation; Fluid Connectors Group; Quick Coupling Div.
d. Snap-Tite; Division of Parker-Hannifin

2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

J. Hose Assemblies: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.

1. Hose: Reinforced double-wire-braid, CR-covered hose for compressed-air service.
2. Hose Clamps: Stainless-steel clamps or bands.
3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with serrated ends for connecting two sections of hose.
4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with serrated ends for connecting two sections of hose.

K. Hose-Reel Assemblies: Individual, retractable hose-reel units with steel face plates, steel mounting boxes, factory- or field-fabricated mounting brackets, and service hoses with adjustable ball stop and service connections matching hoses. Include 50 feet of delivery hose, 2 feet of connecting hose, and quick disconnect. Hose and fittings rated for minimum 125 psig service.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Reelcraft Industries.
b. Hannay Reels Inc.

L. Air Blow Gun:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Legacy; AG7-X.
    b. GuardAir Corporation.
    c. Parker Hannifin Corporation.

2. Steel construction with tapered tip design.
3. Thumb operated.
4. Rubber tip for painted surfaces.
5. Suitable for pressures up to 100-psig.

PART 3 EXECUTION

3.01 PIPING SYSTEM INSTALLATION

A. Drawings, plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.

C. Install air and drain piping with 1 percent slope downward in direction of airflow.

D. Install eccentric reducers where piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

E. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

F. Install flexible pipe connector on each connection to air compressors.

G. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver; install according to Division 20 Section "Meters and Gages."

3.02 VALVE INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping and valve installation.

B. Install metal general-duty valves according to Division 20 Section "Valves."

C. Install shutoff valve at each connection to and from general-service compressed-air specialties, equipment, and accessories. Install strainer if indicated.

D. Install check valves to maintain correct direction of fluid flow to and from compressed-air piping specialties and equipment.

E. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

F. Install automatic drain valves on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

G. Install safety valves where recommended by specialty manufacturers.

3.03 JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

C. Joining of Dissimilar Metal Piping: Use dielectric fittings. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for dielectric fitting types.

3.04 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 20 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
    c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support horizontal piping within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
3. NPS 1-1/2: 12 feet with 3/8-inch rod.
4. NPS 2: 13 feet with 3/8-inch rod.
5. NPS 2-1/2: 14 feet with 1/2-inch rod.
6. NPS 3: 15 feet with 1/2-inch rod.
7. NPS 3-1/2: 16 feet with 1/2-inch rod.
8. NPS 4: 17 feet with 5/8-inch rod.
9. NPS 5: 19 feet with 5/8-inch rod.
10. NPS 6: 21 feet with 3/4-inch rod.
11. NPS 8: 24 feet with 3/4-inch rod.
12. NPS 10: 26 feet with 7/8-inch rod.
13. NPS 12: 30 feet with 7/8-inch rod.

G. Install supports for vertical, Schedule 40, steel piping every 15 feet.

3.05 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to specialties and equipment to allow service and maintenance.

C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.

D. Use metal general-service compressed-air piping between air compressors and air receivers. Use of plastic piping for this application is prohibited.

E. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

F. Specialty and Equipment Flanged Connections: Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.

3.06 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping systems. Refer to Division 20 Section "Mechanical Identification" for labeling and identification materials.

3.07 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

    a. Repair leaks and retest until no leaks exist.

3. Report results in writing.

END OF SECTION 22 15 13

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Testing, Adjusting, and Balancing.”

1.02 SUMMARY

A. This Section includes common requirements for fans and air moving equipment.

1.03 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fan bearings.
2. V-belt fan drives.
3. Direct drive couplings.

1.04 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

B. Fan Performance Data: AMCA Standard 210.

C. Sound Power Level Ratings:

1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 FAN SHAFTS

A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.03 FAN POWER TRANSMISSION

A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.

B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.

C. Base horsepower rating of drive on minimum pitch diameter of small sheave.

D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.

E. Adjust belt tension in accordance with the manufacturer's recommendations.

F. Perform alignment and final belt tensioning in the presence of the Architect.

2.04 SHEAVES

A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.

B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.

C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.

D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.

E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.

F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.05 V-BELT FAN DRIVES

A. Fan Drives: Multiple V-belt style with adjustable pitch driver sheaves for fans up to 2 inches of total static pressure and fixed pitch driver sheaves for fans at or above 2 inches of total static

pressure and up. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.

B. Manufacturers:

1. Emerson Power Transmission; Browning.
2. Rockwell Automation; Dodge.
3. T.B. Wood's Incorporated.

2.06 FAN DRIVE, SHAFT, AND COUPLING GUARDS

A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.

B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.

C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.

D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

E. Centrifugal exhaust fans shall be provided with shaft seals.

2.07 BELT DRIVE GUARDS

A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.

B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.08 V-BELTS

A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than 0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.

B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.

C. Manufacturers:

1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.
3. T.B. Wood's Incorporated; Classical Cog and Narrow Cog V-Belts.

2.09 V-BELT DRIVE MOTOR BASES

A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.

B. Provide for adjustment of both belt tension and alignment.

2.10 AIR HANDLING SYSTEM BALANCING PROVISIONS

A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.

B. Provide sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each existing air handling system requiring rebalancing during air quantity balancing operations. Furnish sheaves as specified in this Section.

2.11 FLEXIBLE COUPLINGS (DIRECT DRIVE)

A. Fan shaft shall be connected to the motor shaft through a flexible coupling. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.

B. Manufacturer:

1. Falk Corporation (The).

2.12 MOTOR REQUIREMENTS

A. Furnish motors in accordance with Division 20 Section “Motors.”

2.13 FAN BEARINGS

A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L_{10} minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.

1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.
2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L_{10} life requirements.

2.14 IDENTIFICATION

A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.15 ACCESSORIES

A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

2.16 ROOFTOP EQUIPMENT ENCLOSURES

A. Description: Louvered or corrugated, direct attached screening system as selected by the Architect.

1. Manufacturers:

a. Spinnaker Industries Inc.

B. Mounts directly to mechanical equipment and requires no roof penetration.

C. Sliding panels provide access to equipment compartments for service and maintenance.

D. Rated to withstand lateral forces developed due to wind speeds of 225 mph.

E. Baked on polyester powder coat finish meeting ASTM B-117 standard for 500 hour salt spray.

2.17 AIR INTAKE PROTECTION SYSTEM

A. Provide custom heavy duty commercial grade air intake protection system including mesh filter fabric, fasteners, and installation on equipment.

B. Mesh fabric constructed with one layer of black PVC-coated polyester high-abrasion media, encased in sewn vinyl edge with single or double stitching and attached via stainless steel grommets. Media shall meet NFPA-701 Flame Resistance.

C. Filter shall have less than 0.05 inch wg initial resistance to air flow, depending on filter media and number of layers required.

D. Filter media shall be heat stabilized, shall not shed fibers, absorb moisture or promote bacterial growth.

E. Inherent electrostatic charge of woven polypropylene (BHC) media shall deliver higher particle arrestance efficiency and enhanced ability to capture and hold smaller particles.

F. Customizable to meet equipment air intake, or ventilation inlet and outlet configuration including those requiring pipe and electrical cut-outs, special shapes, and skirting where grommet attachment to the metal enclosure is not possible. Hook and loop, or magnets shall be added to completely seal air bypass.

G. Suppliers:

1. Permatron Corporation; PreVent System Filter Screen (800-882-8012)
2. Air Solution Company; Cottonwood Filter Screens (800-819-2869)
3. Aero Filter, Inc. (248-837-4100)

PART 3 EXECUTION

3.01 INSTALLATION

A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.

B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.

C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION 23 05 00

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

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PART 1 - PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 ACTION SUBMITTALS

A. Product Data: None.

1.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's drawing designation or unique equipment number.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch(13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three- quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

PART 3 - PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. All insulated, exposed piping larger than 2” and at an elevation of up to 9’-0” above floor shall have a white PVC jacket. All other insulated piping shall have All Service Jacket. Uninsulated piping does not require painting. All piping shall receive adhesive pipe labels, indicating service and flow direction, every 20ft and at changes in direction. Refer to section 230719 for PVC jacket specification.

1. Heating Hot Water: White on Green
2. Chilled Water: White on Green
3. Natural Gas: Black on Yellow

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 DUCT LABEL INSTALLATION

A. All ductwork shall receive adhesive duct labels indicating service and flow direction every 20 ft and at changes in direction and where ducts enter into and exit from concealed spaces.

B. Duct label color coding

1. Air conditioning supply White on Green
2. Air conditioning return: White on Green
3. Exhaust systems: Black on Yellow
4. Outside air intake: White on Green
5. Mixed air: White on Green

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; equipment shutoff valves; convenience and hose connections; and HVAC terminal devices and similar roughing- in connections of end-use units. List tagged valves in a valve schedule.

B. Install glass front frame valve schedule in building mechanical room. Locate at Owners representative approved location.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Common Work Results for HVAC.”

1.02 SUMMARY

A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:

1. Air Systems:

    a. Constant-volume air systems.
    b. Variable-air-volume systems.

2. HVAC equipment quantitative-performance settings.
3. Existing systems TAB.
4. Verifying that automatic control devices are functioning properly.
5. Reporting results of activities and procedures specified in this Section.

B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.03 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. AHJ: Authority having jurisdiction.

C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

F. NC: Noise criteria.

G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

H. RC: Room criteria.

I. Report Forms: Test data sheets for recording test data in logical order.

J. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.

K. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.

L. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

M. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

N. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

O. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

P. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

Q. TAB: Testing, adjusting, and balancing.

R. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

S. Test: A procedure to determine quantitative performance of systems or equipment.

T. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Sample Report Forms: Submit two sets of sample TAB report forms.

1.05 CLOSEOUT SUBMITTALS

A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

B. Warranties specified in this Section.

1.06 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. Approved Balancing Agencies.

1. The TAB firm selected shall be from the following list:

a. Airflow Testing Inc.; Lincoln Park, MI.
b. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
c. Ener-Tech Testing; Holly, MI.
d. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
e. International Test & Balance Inc.; Southfield, MI.
f. Quality Air Service; Portage, MI.
g. Pro-MEC Engineering Services, Inc.; Grand Ledge, MI.
h. Hi-Tech Test & Balance; Freeland, MI.

C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. The Contract Documents examination report.
c. TAB plan.
d. Work schedule and Project-site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.

F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.07 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.08 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.09 WARRANTY

A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

B. Examine system and equipment test reports.

C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

G. Examine strainers for clean screens and proper perforations.

H. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

I. Examine system pumps to ensure absence of entrained air in the suction piping.

J. Examine equipment for installation and for properly operating safety interlocks and controls.

K. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.

C. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.

G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

H. Verify that motor starters are equipped with properly sized thermal protection.

I. Check dampers for proper position to achieve desired airflow path.

J. Check for airflow blockages.

K. Check condensate drains for proper connections and functioning.

L. Check for proper sealing of air-handling unit components.

M. Check for proper sealing of air duct system.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.
5. When existing air handling systems require rebalancing, select required sheave sizes and advise Mechanical Contractor to change drive sheaves accordingly. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.
6. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Power factor.
6. Nameplate and measured voltage, each phase.
7. Nameplate and measured amperage, each phase.
8. Starter size.
9. Starter thermal-protection-element rating.
10. Fuse number and size.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.07 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.08 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Air handling equipment and outlets: Plus or minus 5 percent.

    a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.

2. Heating-Water Flow Rate: 0 to minus 10 percent.
3. Cooling-Water Flow Rate: 0 to plus 5 percent.

3.09 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

a. Indicated versus final performance.
b. Notable characteristics of systems.
c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports varies from indicated values.
14. Test conditions for fans and pump performance forms including the following:

a. Settings for outside-, return-, and exhaust-air dampers.
b. Conditions of filters.
c. Cooling coil, wet- and dry-bulb conditions.
d. Face and bypass damper settings at coils.
e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water flow rates.
3. Terminal units.
4. Balancing stations.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
j. Number of belts, make, and size.
k. Number of filters, type, and size.

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

g. Power factor efficiency.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat coil static-pressure differential in inches wg.
g. Cooling coil static-pressure differential in inches wg.
h. Heating coil static-pressure differential in inches wg.
i. Outside airflow in cfm.
j. Return airflow in cfm.
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.

H. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Fuel type in input data.
    g. Output capacity in Btuh.
    h. Ignition type.
    i. Burner-control types.
    j. Motor horsepower and rpm.
    k. Motor volts, phase, and hertz.
    l. Motor full-load amperage and service factor.
    m. Sheave make, size in inches, and bore.
    n. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Entering-air temperature in deg F.
    c. Leaving-air temperature in deg F.
    d. Air temperature differential in deg F.
    e. Entering-air static pressure in inches wg.
    f. Leaving-air static pressure in inches wg.
    g. Air static-pressure differential in inches wg.
    h. Low-fire fuel input in Btuh.
    i. High-fire fuel input in Btuh.
    j. Manifold pressure in psig.
    k. High-temperature-limit setting in deg F.
    l. Operating set point in Btuh.
    m. Motor voltage at each connection.
    n. Motor amperage for each phase.
    o. Heating value of fuel in Btuh.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Manufacturer's serial number.
    f. Arrangement and class.
    g. Sheave make, size in inches, and bore.
    h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:

    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Suction static pressure in inches wg.

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. System and air-handling unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F.
    d. Duct static pressure in inches wg.
    e. Duct size in inches.
    f. Duct area in sq. ft.
    g. Indicated airflow rate in cfm.
    h. Indicated velocity in fpm.
    i. Actual airflow rate in cfm.
    j. Actual average velocity in fpm.
    k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Test apparatus used.
    d. Area served.
    e. Air-terminal-device make.
    f. Air-terminal-device number from system diagram.
    g. Air-terminal-device type and model number.
    h. Air-terminal-device size.
    i. Air-terminal-device effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Air velocity in fpm.
    c. Preliminary airflow rate as needed in cfm.
    d. Preliminary velocity as needed in fpm.
    e. Final airflow rate in cfm.
    f. Final velocity in fpm.
    g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Entering-water temperature in deg F.
    c. Leaving-water temperature in deg F.
    d. Water pressure drop in feet of head or psig.
    e. Entering-air temperature in deg F.
    f. Leaving-air temperature in deg F.

M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Unit make and model number.
    d. Compressor make.
    e. Compressor model and serial numbers.

2. Test Data (Indicated and Actual Values):

    a. Inlet-duct static pressure in inches wg.
    b. Outlet-duct static pressure in inches wg.
    c. Entering-air, dry-bulb temperature in deg F.
    d. Leaving-air, dry-bulb temperature in deg F.
    e. Condenser entering-water temperature in deg F.
    f. Condenser leaving-water temperature in deg F.

g. Condenser-water temperature differential in deg F.
h. Condenser entering-water pressure in feet of head or psig.
i. Condenser leaving-water pressure in feet of head or psig.
j. Condenser-water pressure differential in feet of head or psig.
k. Control settings.
l. Voltage at each connection.
m. Amperage for each phase.
n. Kilowatt input.
o. Crankcase heater kilowatt.
p. Number of fans.
q. Condenser fan rpm.
r. Condenser fan airflow rate in cfm.
s. Condenser fan motor make, frame size, rpm, and horsepower.
t. Condenser fan motor voltage at each connection.
u. Condenser fan motor amperage for each phase.

N. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model and serial numbers.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.

i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

O. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Measure sound levels at two locations.
e. Measure space pressure of at least 10 percent of locations.
f. Verify that balancing devices are marked with final balance position.
g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 23 09 33 - TEMPERATURE CONTROLS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Testing, Adjusting, and Balancing.”

1.02 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.03 DEFINITIONS

A. BACnet: Communications open protocol for building automation system networks and control (developed by ASHRAE and documented per ANSI/ASHRAE Standard 135-2012.

B. BAS: Building Automation System

C. CAD: Computer Aided Design.

D. DDC: Direct-digital controls.

E. LonWorks (aka LonTalk): Communications open protocol as developed by Echelon Corporation that is utilized with building automation system networks and control.

F. MODBUS: Communications protocol first developed by MODICON for use with PLCs and equipment controllers.

G. TC: Temperature Control.

1.04 SYSTEM DESCRIPTION

A. Temperature control building automation system consisting of direct digital control system controllers, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems.

B. BAS/DDC system programming, database generation. Graphic display generation accessible through Building Network Server or at the remote operator workstation (when applicable for project).

C. Electric thermostats, control valves, dampers, operators, control wiring, etc.

D. Gauges, indicating devices, electric and electronic control accessories, and other control system devices.

1.05 SEQUENCE OF OPERATION

A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.06 SUBMITTALS

A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.

B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valves and automated dampers shall be incorporated with the complete temperature controls submittal.

C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Each control device labeled with setting or adjustable range of control

D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

E. Shop Drawings:

1. Shop drawings shall be done on CAD. Minimum size 11” x 17”.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.
5. Written sequence of operation for each controlled system.
6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
8. Complete bill of materials to identify and quantify all control components.
9. Overall system schematic showing communication trunk cabling from Building Network Server to BAS field level controllers including component locations and wire termination details.

10. DDC controller layouts showing connected data points and LAN connections. DDC controller terminations including power supply and remote-control component termination details shall be provided.
11. Point list for each DDC controller including point descriptions and addresses. This information may be incorporated with DDC controller layouts.

F. Graphic Displays: One month after TC Shop Drawing submittal, TC Contractor shall submit graphical display backgrounds for preliminary Engineer review. Concept for each floor plan, each system, each terminal unit template. Engineer understands that final representation of graphics may not be available until BAS database is established during course of construction. Thorough graphics review will be conducted by Engineer as part of the TC/BAS acceptance procedure.

G. Design Data: Provide indicated component selection and sizing criteria for the following component categories:

1. Dampers:

a. Component tag.
b. Equipment served/function.
c. Overall damper size (inch width x inch height).
d. Quantity of damper sections with respective size(s).
e. Material and gauge of thickness.
f. Mounting orientation (horizontal or vertical).
g. Blade configuration (parallel or opposed)
h. Pressure drop (in. w.g.).
i. Shut-off rating/differential pressure rating (in. w.g.).
j. Leakage rating (CFM/sq. ft. at 4 in. w.g.).
k. Normal position (normally open, normally closed, floating).
l. Actuator spring range (where applicable).
m. Actuator power requirement.
n. Actuator torque requirement.
o. Actuator quantity.
p. Damper manufacturer/model number.
q. Actuator manufacturer/model number.

H. Wall mounted temperature sensor, thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates – coordinate with electrical contractor. Provide samples of available temperature control device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.

I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

J. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.

K. Project Record Documents: Include the following:

1. Revise Shop Drawings to reflect actual installation and operating sequences.
2. Record actual locations of control components, including control units, thermostats, and sensors.
3. Submit the electronic files for all as-built shop drawings on diskette in pdf format.

L. Software and Firmware Operational Documentation: Include the following:

1. DDC controller keypad operating instructions and DDC controller override features, where applicable.
2. Device address list.
3. Program Software Backup: On a magnetic media or compact disc, complete with data files.

M. Maintenance Manuals: Include the following:

1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.
3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Calibration records and list of set points.

1.07 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.

C. ANSI/ASTM B32 - Solder Metal.

D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

F. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.

G. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.

H. ASTM E1 - Specification for ASTM Thermometers.

I. MMC – Michigan Mechanical Code, version applicable for project.

J. NEMA DC 3 - Low-Voltage Room Thermostats.

K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: An experienced/certified installer who is an authorized representative of the existing BAS/DDC control system for the airport with personnel for the maintenance of units required for this Project.

B. Manufacturer Qualifications: Same as Installer Qualifications.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with all applicable code requirements for project.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.

B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.

D. Ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.

F. Coordinate equipment with Division 28 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.

G. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.

H. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

1.11 WARRANTY

A. Provide warranty per Division 20 Section "Mechanical General Requirements" and as supplemented in this section.

B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.

C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight-hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.

D. Provide any software or firmware revisions which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

1.12 POSTED OPERATING INSTRUCTIONS

A. Provide DDC controller related as-built documents in protective binder or clear plastic display envelope for each control enclosure panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 SPECIAL TOOLS

A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, excluding PC laptop.

1.14 PROTECTION OF PROPRIETARY INFORMATION

A. Non-disclosure agreement(s) that may be subject to proprietary manuals and software shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 PRODUCTS

2.01 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)

A. The building automation system (BAS) shall be fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems. Microprocessor based BAS field level DDC controllers shall be directly connected to HVAC equipment sensors and actuators. A data communication network shall allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller. The Building Network Supervisory Controller shall be the primary operator BAS interface point for the building either

through web-browser direct or through server application software (when applicable) or through local or remote Operator Workstation (when applicable to project).

B. Approved Manufacturer – System / Approved Installer (Locations) as listed:

1. Schneider Electric – EcoStruxure / Grand Valley Automation:

2.02 BAS BUILDING NETWORK SERVER (PROPRIETARY PLATFORM)

A. The Building Network Server shall provide the interface between the Owner's Ethernet and the field control devices and provide global supervisory control functions over the control devices connected to the network.

B. The network supervisory controller shall be sized appropriately per building to handle the required quantity of connected controllers and devices.

C. Manufacturers: As listed for Building Automation System.

2.03 DDC DATA COMMUNICATIONS NETWORK

A. Data communication network shall be provided to allow data exchange between the BAS field level DDC controllers and the Building Network Server.

B. The BAS/DDC system-wide communication network shall consist of a primary peer-to-peer network, and at the Contractor's option, secondary sub-networks linked to the primary network. The primary network shall support peer-to-peer communications between primary network BAS field level DDC controllers. The Building Network Server shall be connected to the primary network. Secondary sub-networks when used shall interface with the primary network though the primary network BAS field level DDC controllers. At least one DDC controller connected to the primary peer-to-peer network shall be provided in each mechanical room, or as indicated on the drawings.

C. Data communications media shall be twisted pair wires.

D. The communications network shall allow shared point and control information between BAS field level DDC controllers. All required repeaters, hubs, active links, gateways, etc. and associated power supplies shall be provided as required to provide shared point and control information between BAS field level DDC controllers.

E. Failure of any individual BAS field level DDC controller shall not cause the loss of communications between peer BAS field level DDC controllers.

F. All data transmitted must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgments shall cause a retransmission of the data. Network connected devices must send a "functioning" message each network cycle. Lack of a "functioning" message after successive retries shall constitute a device failure and shall be recognized as such by the network.

G. Error recovery and communication initialization routines shall be resident in each network connected device.

2.04 DIRECT DIGITAL CONTROL (DDC) FIELD LEVEL CONTROLLERS

A. Modular in design and consisting of stand-alone microprocessor board with ROM and fully custom programmable RAM, EPROM, and/or EEPROM memory, integral interface equipment and power surge protection. DDC controllers shall be connected directly to sensors, controlled devices and the communication network.

B. Powerfail Restart and Battery Backup: Minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger or 48-hour low voltage alarm warning. Upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.

C. Provide fully functional communication interface ports for communication between processor, other processors, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.

D. Panel enclosure for controller, associated power supply and other ancillary control components shall be finished steel or rigid plastic with hinged door and keyed lock. Electronics shall be removable for protection during mounting of panel.

2.05 DDC CONTROLLER SOFTWARE

A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC controller communications, scan inputs and outputs, and contain built-in diagnostics.

B. Input/output point processing shall include the following:

1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.
2. Assignment of proper engineering units and status condition identifiers to all points.
3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC input/output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.

C. Command control software shall manage the receipt of commands from control panels, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.

1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the BAS DDC network, not just within the DDC controller. Delays shall be assignable on an individual per point basis.
2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.
4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.

D. Provide self-test procedure. Notify remote Operator Workstation (when applicable for project) for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.

E. Alarm Processing

1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.
2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying values. These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.
3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm shall be generated. Abnormal "on" shall cause an alarm, as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.
4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.
5. The capability of automatically initiating commands upon the occurrence of an alarm.

F. Totalization

1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC controller resident run time limits assignable through portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.
3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. DDC Controller Programming / Configuration

1. All DDC controllers shall be fully programmable or configurable per required controller application type. DDC controllers which require remote or factory programming or configuration are not acceptable. DDC controllers with custom programs which may not be modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.
2. DDC controllers shall be provided to meet the control strategies as called for in the sequences of operation on the drawings. If a configurable application specific DDC controller cannot meet this requirement, a DDC fully programmable controller shall be provided.
3. All DDC controller setpoints, gains, parameters, time constants, etc., associated with DDC controller programs shall be available to the operator for display and modification via portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
4. Each DDC controller shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:

    a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
    b. Logic: OR, AND, compare, negate.
    c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.
    d. Data Manipulation: Store, file and set.
    e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/ software interlock.

H. Building Automation System program applications (as required for controllers)

1. Time of day scheduling: Allow the creation and maintenance of operating schedules for selected points based on time of day and holiday scheduling. At least two independent start and stop times per day for each system shall be allowed. Each point shall be allowed to have a unique time program, or points shall be able to be grouped and assigned to a common time program. Both digital and analog output points shall be able to be assigned to a time program. This software shall work in conjunction with the time of day scheduler software at the remote Operator Workstation (when applicable for project). This program shall also work in conjunction with the optimum start and optimum stop application software.
2. Optimum Start: Start equipment based on outdoor temperature, space temperature, and system response to minimize energy usage and to assure that comfort conditions are reached exactly at scheduled occupancy time (occupancy schedules are defined under "Time Of Day Scheduling"). This program shall operate in both the heating and cooling cycles. An adaptive algorithm shall be employed which automatically adjusts the start time according to previous performance and shall automatically assign longer lead times for weekend and holiday shutdowns.
3. Enthalpy Optimization: Using standard psychrometric calculations, automatically determine which air source, outdoor air or return air, presents the least total heat load, and automatically adjust mixed air damper position. When outside enthalpy exceeds return air enthalpy, the outside air damper shall go to its minimum position. Typically, the outside air damper must be in its minimum position before the cooling coil valve is allowed to open.
4. Duty Cycle: Periodically cycle electrical equipment to reduce energy consumption and/or energy demand. Each load shall be assigned a cycle interval and an off period. A load leveling algorithm shall be utilized to assure that cycle periods do not coincide.
5. Demand Limiting: Distributed power demand program shall be based on a sliding window instantaneous demand algorithm. The DDC controller(s) connected to the demand meter shall calculate the demand, forecast the demand trend, compare it to established demand limits, and initiate load shedding action or reestablishment of loads as required. Shedding shall be on a sequential basis with least important loads shed first and restored last. Restoration cycle shall add the most important loads first. DDC controllers on the network shall each have a four-tier shed table for assignment of sheddable loads. When a request is issued to the network to shed a specific number of kilowatts, each DDC controller shall shed Tier 1 loads, Tier 2 loads, etc. until the shed requirement is met. The program shall have the capability to sum the readings from multiple meters connected to multiple DDC controllers on the network, and to shed various loads from multiple DDC controllers on the network.
6. Warm-Up: Position the outside air dampers in an adjustable (minimum) position and trigger a digital output(s) normally used to signal air terminal units to move to their maximum flow settings. When the desired space temperature is reached, as determined by feedback from space temperature sensor(s), the digital output shall return the air terminal units to their normal operation. When occupancy time is reached, the outside air dampers shall be controlled by the normal occupied mode control sequence. During the warm-up cycle, the outside air damper shall be set at the position which minimizes outside air intake while preventing over/under pressurizing of ductwork. This program

shall work in conjunction with the time scheduling program and/or the optimum start program as required.

7. Night Cycle: Cycle HVAC equipment on and off as required to maintain an operator selectable unoccupied space temperature. During the equipment "on" time, the outside air damper shall be maintained in an adjustable position which minimizes outside air intake while preventing over/under pressurization of ductwork. The equipment shall be cycled such that energy reduction during unoccupied periods is uniform.
8. Night Purge: Night Purge program shall apply to cooling cycle only. Night Purge shall introduce 100% outdoor air any time the outdoor air is above 50 degrees F, the space temperature is above 75 degrees F, the outdoor air temperature is below space temperature and the outdoor air dew point is less than 60 deg F. Purging shall stop when outdoor air is below 50 deg F, or space temperature is below 75 deg F, or outdoor temperature is less than 5 deg F cooler than space temperature, or outdoor air dew point is greater than 60 deg F.
9. Reset Optimization: Adjust equipment discharge setpoints based on one of the following criteria:

    a. By sensing the worst-case requirements (e.g., the zone requiring the most heating or cooling and providing only the minimum energy required to meet the load.
    b. Adjusting the setpoint in direct proportion to another sensed variable (e.g., reset supply water temperature based on outside temperature).

2.06 DDC INPUT/OUTPUT SENSORS

A. Air Static/Differential Pressure Transmitters:

1. Variable capacitance type with ranges not exceeding 150 percent of maximum expected input. Transmitter shall have zero and span adjustments.
2. Safe overpressure rating shall be minimum 5 times the range.
3. Temperature compensated with thermal error of not greater than 0.04 percent of full scale in temperature range of 40 to 100 deg F.
4. Accuracy: +/- 0.5% of full-scale including calibration error, repeatability, hysteresis, and yearly drift.
5. Manufacturers:

    a. Air Monitor.
    b. Belimo.
    c. Dwyer.
    d. Modus
    e. Setra.

B. Current Switches:

1. Split-core or donut type transformer for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.

2. Current switches with digital output shall have adjustable trip settings. Provide field adjustment of current switches to trip at approximately 90% of normal motor operating amperage.
3. Manufacturers:

    a. Johnson Controls.
    b. NK Technologies.
    c. Senva.
    d. Setra.
    e. Veris Industries.

C. Outside Air Temperature/Humidity Combination Transmitters:

1. Dual transmitters housed in a single hinged enclosure with integral probes configured for exterior wall mount application with PVC sun shield. Unit shall provide separate 4-20 mA signals for temperature and humidity measurement.
2. Temperature sensor: Refer to Temperature Sensors specifications. Range of operation shall be -25 degrees F to 125 degrees F.
3. Humidity sensor: Refer to Humidity Sensors specifications. Range of operation shall be 0-100% RH.
4. Manufacturer:

    a. Belimo.
    b. Vaisala.
    c. Veris.

D. Temperature Sensors:

1. Resistance temperature detectors (RTD) with 1000 ohm, thin-filmed platinum, nickel or Balco element having 0.000385 temperature coefficient meeting the input requirements of the DDC controller.
2. Thermally sensitive resistors (thermistor) shall be 10k-type, epoxy or glass coated, having NTC characteristic, meeting the input requirements of the DDC controller.
3. Initial calibration accuracy shall be +/- 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.
4. Additional error such as repeatability, stability, tolerance, linearity and hysteresis shall not exceed an additional +/- 0.5 deg F additive (using RMS method) throughout the selected operating range for the application.
5. Temperature sensors shall be resistant to chlorine and other cleaning agents
6. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20 - 120°F.
7. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20 - 120°F.
8. Liquid immersion sensors shall have welded stainless steel thermowells for ferrous pipe and brass thermowells for copper pipe. Length of sensor and thermowell shall be selected based on the diameter of the pipe to provide accurate, reliable and homogeneous sensing of the liquid temperature. Thermowell pressure rating shall meet or exceed the system

minimum pressure rating. Sensors for chilled water application shall have calibrated span of 20 - 120°F. Sensors for hot water applications shall have calibrated span of 40 - 240°F

9. Room sensors shall have locking cover and a minimum span of 40 - 90°F.
10. Outside air temperature (only) sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun and wind.
11. Manufacturers:

    a. Specified BAS product where available that meets the requirements herein.
    b. ACI – except PT1000 averaging sensor.
    c. BAPI – Basys Series.
    d. Belimo.
    e. MAMAC
    f. Minco.
    g. TCS.

2.07 CONTROL AND INSTRUMENTATION TUBING

A. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.

1. Fittings: ANSI/ASME B16.22, wrought copper.
2. Joints: ANSI/ASTM B32, 95-5 tin antimony.

B. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.

1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
2. Joints: Ball Sleeve compression type.

C. Polyethylene Tubing: Black, UL 1820 flame and smoke retardant where exposed in an air plenum, virgin polyethylene, conforming to modified ASTM D1693 test. All non-metallic tubing shall be minimum 1/4" O.D.; micro-sleeve is not acceptable.

1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
2. Joints: Compression or barbed type.

2.08 DAMPERS - AUTOMATED

A. Performance: Test in accordance with AMCA 500.

B. Frames: Galvanized steel, minimum 16 gauge, minimum 2 inches in width, welded or riveted with corner reinforcement for 12 gage structural equivalence.

C. Blades: Galvanized steel, minimum 14-gauge, maximum blade size 8 inches wide, 60 inches long, attached to minimum 1/2-inch shafts. Dampers which are required to have a static pressure rating over 4-inch W.G. shall have minimum 3/4-inch solid shafts.

D. Blade Seals: Synthetic elastomeric or Neoprene, mechanically attached, field replaceable.

E. Jackshafts (where required): Minimum 1/2-inch galvanized steel.

F. Jamb Seals: Stainless steel.

G. Bearings: Oil impregnated sintered bronze or lubricant free, solid stainless steel. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.

H. Linkages: Accessible for maintenance. Linkages may be located in airstream. Linkages located in damper frame shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be zinc plated.

I. Leakage: Less than 8 CFM per square foot based on 4 inches W.G. pressure differential.

J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4" W.G.

K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.

L. Temperature Limits: -40 to 200 deg F.

M. Manufacturers:

1. American Warming & Ventilating.
2. Arrow United Industries.
3. Greenheck.
4. Honeywell.
5. Johnson Controls.
6. Louvers & Dampers, Inc.
7. Ruskin.
8. Tamco.
9. Vent Products.

2.09 DAMPERS, INSULATED OUTDOOR AIR / RELIEF AIR / EXHAUST AIR - AUTOMATED

A. Performance: AMCA certified for Air Performance and Air Leakage.

B. Frames: Extruded aluminum, .080-inch thickness minimum, 4 inches deep minimum, thermally broken, and insulated with polystyrene or polyurethane foam insulation.

C. Blades: Extruded aluminum, internally insulated, and thermally broken. Maximum blade size 8 inches wide, 60 inches long.

D. Shafts: Minimum 7/16 inch hexagonal or square corrosion resistant zinc plated steel.

E. Blade Seals: Extruded EPDM, silicone, or synthetic elastomeric, mechanically attached.

F. Jamb Seals: Silicone, or synthetic elastomeric, mechanically attached.

G. Bearings: Dual bearing assembly of durable synthetic polymer resulting in no metal-to-metal contact. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.

H. Linkage: Linkage shall be installed in the frame side and shall be constructed of aluminum and/or corrosion resistant zinc plated steel.

I. Leakage: Less than 3 CFM per square foot at 1-inch W.G. pressure differential at minus 40 deg F.

J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4 inches W.G.

K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.

L. Temperature Limits: Minus 40 to 155 deg F.

M. Manufacturers:

1. Greenheck ICD-45.
2. Ruskin CDTI-50BF.
3. Tamco Series 9000 BF

2.10 DAMPER OPERATORS - ELECTRIC

A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.

B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.

C. Manufacturers:

1. Belimo.
2. Delta Control Products.
3. Honeywell.
4. Schneider Electric Controls.
5. Johnson Controls.
6. Siemens.

2.11 LIMIT SWITCHES

A. Oil tight type with operator as required providing required function. Limit switches used on dampers should be set at approximately 75% of full stroke.

B. Manufacturers:

1. Allen-Bradley.
2. General Electric.
3. Square D.
4. Westinghouse.
5. Micro-switch.

2.12 THERMOSTATS – ELECTRONIC & ELECTRIC

A. Line Voltage Room Thermostats: Adjustable single setpoint with exposed setpoint indicator and exposed thermometer for a range of 55 deg F to 85 deg F with maximum dead band of 1-1/2 degrees F, and locking cover. Contacts shall be rated for load, single-pole or two-pole as required. Provide with integral manual On/Off/Auto selector switch where indicated on control details. Power Requirement: 24 Vac or 120 Vac as required.

B. Room Thermostat Accessories:

1. Thermostat Covers: Manufacturers standard with finish as selected by Architect.
2. Insulating Bases: Provide one-inch insulating base for thermostats located on exterior walls.
3. Adjusting Key: As required for device.

C. Manufacturers for listed Thermostat Types:

1. Honeywell International, Inc.
2. Johnson Controls, Inc.
3. Schneider Electric USA, Inc.
4. Siemens Industry, Inc.; Building Technologies Division.
5. White-Rodgers Div.; Emerson Electric Co.

2.13 LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.

B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.

C. Panels shall be sized for a maximum fill of 50% capacity and shall not be smaller than 24" X 24".

2.14 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.

B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.

C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e., above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).

D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.

E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.

F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.

G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

PART 3 EXECUTION

3.01 INSTALLATION - CONTROL SYSTEMS

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.

C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.

D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.

E. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC controller as the associated output signal.

F. Provide conduit and electrical wiring where required.

G. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize “Wiremold” routing.

H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.

I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.

J. Coil and conceal excess capillary on remote element instruments.

K. Install thermometers in air duct systems on flanges.

L. Install all gauges and thermometers in locations where they are easily read from normal floor level. Provide tubing or wiring as required.

M. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.

N. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.

O. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.

P. Locate, support, and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture, or other harmful conditions beyond their rated limitations.

Q. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.

R. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.

S. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 105 seconds.

3.02 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS

A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor’s option to schedule a meeting at the Engineer’s Office to review project design documentation for clarification

purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request of Information (RFI) process.

B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop drawing submittal is complete, and Engineer is confident that documents are going to lead to an installation that meets project design intent.

C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include

1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
2. Graphics generation requirements including special Owner requirements and schedule for completion.
3. Owner training agenda and scheduling.
4. TC/BAS system acceptance procedures.

3.03 IDENTIFICATION AND MARKING

A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.

B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.

C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.

D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached on the front exterior with panel identification to match details of temperature control submittals and include system(s) served and area(s) served on the labeling. Include labeling near 120VAC terminations within panel identifying power source panel ID and specific circuit breaker used.

E. Temperature control conduit and junction box covers shall be painted a color to signify that it is used for temperature controls. All junction box covers shall be painted a color and the conduit shall be painted with a color mark (approximately 6 inches long) every 36" to 48", and on both sides of all penetrations.

3.04 GRAPHIC DISPLAY GENERATION

A. Provide the following graphic displays as a minimum at the operator interface, arranged in logical penetration paths:

1. Overall campus layout which shows all of the buildings on the Owner's campus.
2. Individual building layout or isometric for each building connected to the system.
3. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.
4. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:

    a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
    b. System name.
    c. Area served.
    d. Present value or status of all inputs, along with present setpoint.
    e. Present percent open for each damper, valve, etc. based on commanded position.
    f. Reset schedule parameters for all points, where applicable.
    g. Present occupancy mode.
    h. Present economizer mode, where applicable.
    i. Present outside air temperature.
    j. Associated space conditions and setpoints, where applicable.
    k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
    l. Color coding to indicate normal and abnormal values, alarms, etc.

5. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc.) shall be provided. Graphic display of output point auto or manual override status shall be provided.
6. Sequence of operation in written (text) format for each HVAC system.
7. Overall BAS system schematic.
8. System management graphic for each network device and/or DDC controller.

3.05 OWNER INSTRUCTION AND TRAINING

A. Provide a minimum of forty (40) hours of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.

B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.

C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.

D. Provide 5 sets of computer training & tutorial CD's describing workstation operation and functions.

E. Provide 5 sets of literature pertaining to the operation and maintenance of the DDC system components provided.

3.06 CALIBRATION AND START-UP

A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.

B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.07 ACCEPTANCE PROCEDURE

A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.

B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.

D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION 23 09 33

SECTION 23 11 23 - FUEL GAS PIPING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 SUMMARY

A. This Section includes facility fuel gas piping.

B. Service meter assemblies will be furnished and installed by utility company.

1.03 DEFINITIONS

A. Gas Main: Utility's natural gas piping.

B. Gas Distribution: Piping from gas main to individual service-meter assemblies.

C. Service-Meter Assembly: Piping, valves, service regulator, service meter, and specialties.

D. Point of Delivery: Piping outlet from service-meter assembly.

E. Fuel Gas Piping: Piping that conveys fuel gas from point of delivery to fuel gas utilization devices.

F. PE: Polyethylene.

1.04 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: Performance requirements are scheduled on the Drawings.
2. Exception: Fuel Gas Piping Installed within Ceilings Used as Plenums: 150 psig.

1.05 SYSTEMS DESCRIPTIONS

A. Fuel gas piping system materials are scheduled on the Drawing.

1.06 ACTION SUBMITTALS

A. Product Data: For the following:

1. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
2. Pressure regulators. Include pressure rating, capacity, and settings of selected models.

1.07 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For fuel gas piping. Include plans and attachments to other work. Show different pressure zones and indicate pressure for each zone.

1.08 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For natural gas specialties and accessories to include in operation and maintenance manuals.

1.09 QUALITY ASSURANCE

A. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. NFPA Standard: Comply with NFPA 54, "National Fuel Gas Code."

1.10 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.11 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Gas System Pressure: Not more than 5.0 psig.

C. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 1000 Btu/cu. ft.
2. Nominal Specific Gravity: 0.6.

1.12 COORDINATION

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 BLACK STEEL PIPE AND FITTINGS

A. Black Steel Pipe: ASTM A 53/A 53M or ASTM A 106; Type E or S; Grade B; Schedule 40. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
6. Joint Compound and Tape: Suitable for natural gas.
7. Steel Flanges and Flanged Fittings: ASME B16.5.
8. Gasket Material: Thickness, material, and type suitable for natural gas.

2.03 PIPING SPECIALTIES

A. Flexible Connectors: ANSI Z21.24, copper alloy.

B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.04 JOINING MATERIALS

A. Refer to Division 20 Section “Basic Mechanical Materials and Methods.”

2.05 SPECIALTY VALVES

A. Valves, NPS 3 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

B. Valves, NPS 4: Threaded ends according to ASME B1.20.1 for pipe threads; or flanged ends according to ASME B16.5 for steel flanges.

C. Valves, NPS 6 and Larger: Flanged ends according to ASME B16.5 for steel flanges.

D. Natural Gas Valves, NPS 3 and Smaller: Use the following:

1. Ball Valves: Bronze or brass body with AGA or CSA stamp, UL listed or FM approved for service, with chrome-plated brass ball and lever handle; 125-psig minimum pressure rating.

a. Manufacturers:

1) Apollo Valve; Conbraco Industries, Inc.
2) Jomar International Ltd.
3) Legend Valve and Fitting, Inc.
4) Milwaukee Valve Company.
5) NIBCO INC.
6) Watts Water Technologies, Inc.; Watts Regulator Co.

b. Tamperproof Feature: Include design for locking.

E. Natural Gas Valves, NPS 4: Use any of the following:

1. Cast-Iron, Eccentric Plug Valves:

a. Manufacturers:

1) Homestead Valve; a division of Olson Technologies, Inc.; Keycentric Series 300.
2) Milliken Valve Company; Mueller Water Products; Model 625.

b. Approvals: UL approved.
c. Body: Cast iron, complying with ASTM A 126, Class B.
d. Plug: Bronze or nickel-plated cast iron.
e. Stem Seal: Compatible with natural gas.
f. Resilient Plug Seal: Compatible with natural gas.
g. Operator: Square head or lug type with tamperproof feature where indicated.
h. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
i. Pressure Class: 125 psig.

F. Natural Gas Valves, NPS 6 and Larger: Use any of the following:

1. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

a. Manufacturers:

1) Flowserve Nordstrom.
2) Homestead Valve; a division of Olson Technologies, Inc.
3) R&M Energy Systems, a Unit of Robbins & Myers, Inc.; Resun.

b. Body: Cast iron, complying with ASTM A 126, Class B.
c. Plug: Bronze or nickel-plated cast iron.
d. Seat: Coated with thermoplastic.
e. Stem Seal: Compatible with natural gas.
f. Operator: Square head or lug type with tamperproof feature where indicated.
g. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
h. Pressure Class: 125 psig.

2. Class 150, Full-Port, Carbon-Steel Ball Valves:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Apollo Valve; Conbraco Industries, Inc.; 88A-200-UL Series.
2) Metso Automation; Jamesbury Valves.

b. UL listed.
c. Split-body construction.
d. Chrome-plated carbon steel ball.
e. Reinforced PTFE seats.
f. Lever actuation.

2.06 PRESSURE REGULATORS

A. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.

1. Manufacturers:

a. Line Pressure Regulators:

1) Elster Gas North America; Elster American Meter.
2) Fisher Controls International, Inc.; Division of Emerson Process Management.
3) Itron Gas.

b. Appliance Pressure Regulators:

1) Elster Gas North America; Elster American Meter.
2) Elster Gas North America; Elster Canadian Meter.
3) Fisher Controls International, Inc.; Division of Emerson Process Management.
4) Maxitrol Company; 325 Series.

2. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
3. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges.
4. Service Pressure Regulators: ANSI Z21.80. Include 100-psig- minimum inlet pressure rating.
5. Line Pressure Regulators: ANSI Z21.80/GCA 6.22 or ANSI B109.4/CGA 6.18, with inlet pressure rating as scheduled on the Drawings.

a. Regulators for Generator Sets: Direct operated, fast acting type.

6. Appliance Pressure Regulators: ANSI Z21.18. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

B. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

PART 3 EXECUTION

3.01 EXCAVATION

A. Refer to Division 31 Section “Earthwork” for excavating, trenching, and backfilling.

3.02 EXAMINATION

A. Examine roughing-in for fuel gas piping system to verify actual locations of piping connections before equipment installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.04 PIPING SYSTEM INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.

E. Concealed Locations:

1. Above Inaccessible Ceiling Locations: Gas piping with welded joints may be installed in inaccessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above inaccessible ceilings.
2. Above Accessible Ceiling Locations: Gas piping with welded joints may be installed in accessible ceiling spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above ceilings used as plenums.
3. In Floor Channels: Gas piping may be installed in floor channels, subject to approval of authorities having jurisdiction. Channels must have cover and be open to space above cover for ventilation.
4. In Partitions: Do not install concealed piping in solid partitions, unless installed in a chase or casing.

    a. Exception: Piping passing through partitions or walls.

5. In Walls: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in masonry walls, subject to approval of authorities having jurisdiction.
6. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

F. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.

G. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.

H. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

I. Connect branch piping from top or side of horizontal piping.

J. Install pressure gage upstream and downstream from each line pressure regulator. Pressure gages are specified in Division 20 Section "Meters and Gages."

K. Locate valves for easy access.

L. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

M. Install flanges when connecting to valves, specialties, and equipment having NPS 2-1/2 and larger connections.

N. Install gas valve or plug valve and strainer upstream from each line pressure regulator or appliance pressure regulator.

O. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

P. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.05 JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Use materials suitable for fuel gas.

C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.06 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 20 Section "Hangers and Supports."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

C. Support vertical steel pipe at each floor and at spacing not greater than 15 feet.

3.07 CONNECTIONS

A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.

B. Install piping adjacent to appliances to allow service and maintenance.

C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

3.08 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.

1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

2. Nameplates, pipe identification, and signs are specified in Division 20 Section "Mechanical Identification."
3. Trace Wire: Yellow insulated, minimum 18 AWG wire, having copper or other approved conductor, with insulation suitable for direct burial, installed adjacent to underground nonmetallic piping, with aboveground access to tracer wire at each end of pipe.

3.09 PAINTING

A. Use materials and procedures in Division 09 painting Sections.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Color: Gray.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Division 03.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections during business hours.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

C. Additional Testing: Subject welded fuel gas piping installed within ceiling spaces used as plenums to test pressure of 150 psig for a minimum of 2 hours.

D. Natural-gas piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, and maintain lubricated plug valves.

END OF SECTION 23 11 23

SECTION 23 31 13 - METAL DUCTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1.02 SUMMARY

A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.

1.03 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.

C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm.

D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm.

E. FRP: Fiberglass-reinforced plastic.

F. PVC: Polyvinyl Chloride.

1.04 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.05 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Application Schedule" Article.

1.06 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

1.07 QUALITY ASSURANCE

A. NFPA Compliance:

1.08 COORDINATION

A. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

B. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.

C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and No. 4 for exposed ducts.

E. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

F. Reinforcement Shapes and Plates:

1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
2. Compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods:

1. Galvanized Steel Duct: Galvanized steel, 3/8-inch minimum diameter.
2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches. ZERO-CLEARANCE PREFABRICATED RANGE HOOD EXHAUST DUCT

H. Manufacturers:

1. AMPCO; American Metal Products; Model IVSI-4ZC.
2. Metal-Fab Inc.; Model IPIC-3G/4G.
3. Schebler Chimney Systems; FyreGuard.
4. Selkirk Inc.; Selkirk Metalbestos; ZeroClear Z3.

I. Description: Factory-fabricated, -listed, and -labeled, double-wall ducts tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211, and suitable for zero-clearance installations.

J. Construction: Inner shell and outer jacket separated by a 3-inch to 4-inch annular space filled with high-temperature, ceramic-fiber insulation.

1. Inner Shell: ASTM A 666, Type 304 stainless steel.
2. Outer Jacket: Aluminized steel indoors and Type 304 stainless steel outdoors. Seams shall be fully welded.

K. Gaskets and Flanges: Ensure that gaskets and sealing materials are rated at 1500 deg F minimum.

L. Hood Connectors: Constructed from same material as grease duct with internal or external continuously welded or brazed joints.

M. Accessories: Tees, elbows, increasers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters, and drain fittings.

N. Grease Duct Supports: Construct duct bracing and supports from non-combustible material.

1. Design bracing and supports to carry static and seismic loads within stress limitations of the International Building Code.
2. Ensure that bolts, screws, rivets and other mechanical fasteners do not penetrate duct walls.

2.03 SEALANTS AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.

1. Manufacturers:

a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.

C. Water-Based Joint and Seam Sealant:

1. Manufacturers:

a. Design Polymerics; DP1010 Water Based Duct Sealant.
b. Hardcast; Flex-Grip 550 and Versa-Grip 181.
c. Polymer Adhesives; No. 11.
d. United McGill.

2. Application Method: Brush on.
3. Solids Content: Minimum 63 percent.
4. Shore A Hardness: Minimum 20.
5. Water resistant.
6. Mold and mildew resistant.
7. VOC: Maximum 75 g/L (less water).
8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Manufacturers:

a. Hardcast; Sure-Grip 404.
b. United McGill.

2. Application Method: Brush on.
3. Base: Synthetic rubber resin.
4. Solvent: Toluene and heptane.
5. Solids Content: Minimum 60 percent.
6. Shore A Hardness: Minimum 60.
7. Water resistant.
8. Mold and mildew resistant.
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

F. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

2.04 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
4. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

E. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.

1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.

    a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
    b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
4. Manufacturers:

    a. B-Line by Eaton; KwikWire.
    b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
    c. Duro Dyne Corp.; Dyna-Tite System.
    d. Gripple Inc.; Hang-Fast System.

F. Stainless Steel Load Rated Cable Suspension System for Corrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.

1. Cable: Aircraft quality stainless steel 7 x 7 and 7 x 19 wire rope.

    a. Stainless steel complying with ASTM A 492.

2. Fastener: One-piece, stainless steel housing with Type 302 S26 stainless steel hardened and tempered springs, and ceramic locking wedges.
3. End Fixings:

    a. Loop End: Type 316L/A4 stainless steel.
    b. Stud or Toggle End: Type 304L/A2 stainless steel.
    c. Plain end suitable for stainless steel wire rope beam clamp.

4. Manufacturers:

    a. B-Line by Eaton; KwikWire.
    b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
    c. Duro Dyne Corp.; Dyna-Tite System.
    d. Gripple Inc.; Hang-Fast System.

G. Welded Supports: Structural steel shapes with zinc rich paint. Equivalent, proprietary design, rolled steel structural support systems may be used in lieu of mill rolled structural steel.

2.05 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
3. Internal Tie Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:

    a. Ductmate Industries, Inc.
    b. Nexus Inc.
    c. Ward Industries, Inc.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.06 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA “Industrial Duct Construction Standards” as required based on pressure class.

1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA “Industrial Duct Construction Standards” as required based on pressure class.

1. Flat-oval fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

D. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
5. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
6. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

E. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)

1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
2. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

F. Medium and High Pressure Ductwork (For Static Pressure Class Greater than plus or minus 2 inches W.G.)

1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
2. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
3. Fabricate continuously welded medium and high pressure round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
4. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

G. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

H. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

I. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:

    a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
    b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
    c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:

    a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
    b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
    c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

J. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:

1. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.
2. Round Elbows 9 to 26 Inches in Diameter: Standing-seam construction.
3. Round Elbows 28 to 60 Inches in Diameter: Standard gored construction, riveted and bonded.
4. Other Fittings: Riveted and bonded joints.
5. Couplings: Slip-joint construction with a minimum 2-inch insertion length.

PART 3 EXECUTION

3.01 DUCTWORK APPLICATION SCHEDULE

A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.02 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."

1. Where ducts not having fire dampers, smoke dampers, or combination fire and smoke dampers pass through fire-rated partitions, maintain indicated fire rating. Seal penetrations with firestop materials. Refer to Division 07 Specification Sections for materials and UL classified firestop systems.

O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

P. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

1. Intermediate level.

3.03 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.04 DUCT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer’s instructions.

1. Seal Class: Refer to Application Schedule on the Drawings.
2. Seal ducts before external insulation is applied.
3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

D. Install concrete inserts before placing concrete.

E. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.

F. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

G. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.

H. Use load rated cable suspension system for round duct in exposed locations.

3.06 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.08 FIELD QUALITY CONTROL

A. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

B. Duct system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.09 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23 31 13

SECTION 23 34 23 - POWER VENTILATORS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Motors.”
3. Division 20 Section “Variable Frequency Controllers.”
4. Division 23 Section “Common Work Results for HVAC” for common mechanical drive requirements for fans and air moving equipment.

1.02 PERFORMANCE REQUIREMENTS

A. Classify according to AMCA 99.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For power ventilators to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.08 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-drive unit.

PART 2 PRODUCTS

2.01 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing; Acme Fan Group.
2. Aerovent; a Twin City Fan Company.
3. Greenheck Fan Corporation; SQ/BSQ Series.
4. Loren Cook Company.
5. Moffitt Corporation.
6. PennBarry; Division of Air System Components.

B. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Casing: Rectangular or cylindrical, flanged.

D. Throat and Mounting Assembly: One-piece spun aluminum or continuously welded assembly.

1. Stiffeners: Continuously welded.
2. Bolts, nuts, rivets, and washers: Cadmium plated.
3. Nuts: Self-locking type, vibration proof.

E. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

F. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

G. Fan Wheels: Aluminum, backward curved airfoil blades welded to aluminum hub.

H. Accessories:

1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

I. Capacities and Characteristics: Refer to schedule(s) on Drawings.

J. Vibration Isolators: Refer to Division 20 Section “Mechanical Vibration Controls.”

2.02 PROPELLER FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing; Acme Fan Group.
2. Aerovent; a Twin City Fan Company.
3. Greenheck Fan Corporation.
4. Loren Cook Company.
5. Moffitt Corporation.
6. Peerless Blowers.
7. PennBarry; Division of Air System Components.

B. Description: Direct-or belt-driven propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.

C. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

D. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

E. Fan Wheel: Replaceable, cast-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

F. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Sheaves: Cast iron with split, tapered bushing; dynamically balanced at factory.
4. Motor Sheaves: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select sheave so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
6. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
7. Refer to Division 23 Section “Common Work results for HVAC” for additional requirements.

G. Accessories:

1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Weathershield Hood: Galvanized steel to match fan and accessory size.
5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
6. Variable Frequency Controller: Refer to Division 20 Section “Variable Frequency Controllers.”
7. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

I. Vibration Isolators: Refer to Division 20 Section “Mechanical Vibration Controls.”

2.03 MOTORS

A. Comply with requirements in Division 20 Section "Motors."

2.04 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.01 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using elastomeric mounts having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."

C. Install floor-mounting units as specified in Division 20 Section "Mechanical Vibration Controls."

D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor sheaves as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 23 34 23

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

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2.01 AIR DIFFUSION DEVICES 1
2.02 SOURCE QUALITY CONTROL 2
PART 3 EXECUTION 2
3.01 EXAMINATION 2
3.02 INSTALLATION 3
3.03 ADJUSTING 3

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.02 ACTION SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 PRODUCTS

2.01 AIR DIFFUSION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
2. Nailor Industries, Inc.
3. Price Industries.
4. Titus; Air Distribution Technologies, Inc.; a JCI Company.
5. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.

B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.

C. Provide plaster frames for units installed in plaster ceilings.

D. Provide gaskets for supply terminal air devices mounted in finished surfaces.

E. Finish:

1. Device Face and Visible Trim: Standard off-white baked enamel finish unless noted otherwise.
2. Device Interior Surfaces, Including Blank-Offs and Boots: Black matte finish.

F. Air pattern adjustments shall be made from the face of the device.

G. Refer to drawings and schedules for quantities, types, and finishes.

H. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.02 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, “Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.”

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.

D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 55 23 - GAS-FIRED INFRARED HEATERS

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2.01 MANUFACTURERS 2
2.02 LOW INTENSITY TUBULAR INFRARED HEATERS 2
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3.04 FIELD QUALITY CONTROL 5
3.05 ADJUSTING 5
3.06 DEMONSTRATION 5

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings:

1. Wiring Diagrams: Power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Field Quality-Control Test Reports: From Contractor.

B. Operation and Maintenance Data: For fuel-fired radiant heaters to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

B. Source Limitations: Obtain fuel-fired radiant heaters through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of fuel-fired radiant heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 LOW INTENSITY TUBULAR INFRARED HEATERS

A. Manufacturers:

1. Combustion Research Corporation; Reflect-O-Ray.
2. Detroit Radiant Products Company; Re-Verber-Ray.
3. Gas-Fired Products, Inc.; Space-Ray Div.
4. Reznor HVAC; Nortek Global HVAC.
5. Roberts-Gordon; a brand of Specified Air Solutions; Vantage II.
6. Solaronics, Inc.

B. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.6, "Gas-Fired Infrared Heaters."

1. CSA Approval: Certified by and bearing label of CSA International.
2. Type of Gas: Designed and built to burn natural gas with characteristics same as those of gas available at Project site.

C. Combustion Tubing: Stainless or aluminized steel with high-emissivity, high-temperature, corrosion-resistant external finish.

D. Tubing Connections: Stainless-steel couplings or flared joints with stainless-steel draw bolts.

E. Reflector: Polished aluminum, 97 percent minimum reflectivity, with end caps. Shape to control radiation from tubing for uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Provide for rotating reflector or heater around a horizontal axis for minimum 30-degree tilt from vertical.

1. Reflector Extension Shields: Same material as reflectors, arranged for fixed connection to lower reflector lip and rigid support to provide 100 percent cutoff of direct radiation from tubing at angles greater than 30 degrees from vertical.
2. Include hanger kit.

F. Burner Safety Controls:

1. Gas Control Valve: Two-stage, regulated redundant 24-V ac gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
2. Blocked Vent Safety: Differential pressure switch in burner safety circuit to stop burner operation with high discharge or suction pressure.
3. Control Panel Interlock: Stops burner if panel is open.
4. Indicator Lights: Burner-on indicator light.

G. Burner and Emitter Type: Gravity-vented power burner, with the following features:

1. Emitter Tube: 4-inch diameter aluminized-steel first 10 feet, hot-rolled-steel tubing remainder or unit, with sight glass for burner and pilot flame observation.
2. Venting: Connector at exit end of emitter tubing for vent-pipe connection.

    a. Vent Terminal: Vertical.

3. Burner/Ignition: Stainless-steel burner cup and head with balanced-rotor draft fan and direct-sensing, hot-surface ignition.
4. Combustion-Air Connection: Duct connection for combustion air to be drawn directly from outside by burner fan.

2.03 TEMPERATURE CONTROL

A. Wires and cables are specified in Division 26 Section "Conductors and Cables."

B. Sensors, Components, and Wiring: Specified in Division 23 Section "Temperature Controls."

C. Thermostat: 2-stage, 24-V ac, wall-mounting type with 50 to 90 deg F operating range and fan on switch.

1. Control Transformer: Integrally mounted, 120 to 24 V ac.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for radiant heater piping systems to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install radiant heaters level and plumb.

B. Install and connect gas-fired radiant heaters and associated fuel and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written installation instructions.

C. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Gas Piping: Comply with applicable requirements in Division 23 Section "Fuel Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service. Provide CSA-approved flexible units.

D. Connect vents according to Division 23 Section "Breechings, Chimneys, and Stacks."

E. Electrical: Comply with applicable requirements in Division 26 Sections.

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

F. Ground equipment according to Division 26 Section "Grounding and Bonding."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Test Reports: Prepare a written report to record the following:

    a. Test procedures used.
    b. Test results that comply with requirements.
    c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.05 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fuel-fired radiant heaters.

END OF SECTION 23 55 23

SECTION 23 73 39 - DIRECT-FIRED H&V UNITS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section “Common Work Results for HVAC” for mechanical drive requirements common to fans and air moving equipment.

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

1.03 INFORMATIONALSUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
2. Wiring Diagrams: Power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Startup service reports.

B. Operation and Maintenance Data: For direct-fired H&V units to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of direct-fired H&V units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70 and 90A.

D. Conform to the National Fuel Gas Code (NFPA 54 / ANSI Z223.1)

E. Product shall be ETL Listed.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with applicable requirements in Division 20 Section “Basic Mechanical Materials and Methods.”

B. Deliver equipment in original crates, boxes, and shipping containers.

C. Do not lift air handling equipment by slings placed over shaft ends, and do not drop equipment off truck beds.

D. Store air handling equipment in a manner to prevent windmilling.

E. Rotate shafts periodically to prevent puddle corrosion of bearing races.

F. Close openings of air handling equipment to prevent entry of dirt and foreign matter.

G. On air handling equipment expected to be stored or to remain unused for extended periods, protect bearings from corrosion and contamination using method recommended by bearing manufacturer.

1.07 COORDINATION

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of direct-fired H&V units that fail in materials or workmanship within specified warranty period.

1. Unit shall be provided with a 24 month parts warranty from date of startup.
2. First year service labor shall be provided by the installing contractor.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set for each unit.
2. Fan Belts: One set for each unit.

PART 2 PRODUCTS

2.01 COMMERCIAL DIRECT-FIRED H&V UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Modine Manufacturing Company.
3. Nortek Air Solutions; Venmar CES.
4. Rapid Engineering, LLC; 2000 Series.
5. Reznor HVAC.
6. RuppAir.
7. Sterling HVAC; Mestek, Inc.
8. Trane; a Trane Technologies Brand.

B. Description:

1. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, filters, and direct-fired gas furnace to be installed inside the building.
2. Discharge: Horizontal or vertical-pattern as indicated, galvanized-steel assembly with diffusers incorporating individually adjustable vanes.

C. Cabinet (Indoor):

1. Cabinet: Double-wall, minimum 20-gage galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs.
2. Access Panels: Lift-out or piano hinged with tooled or cam-lock fasteners for furnace, filters, and fan motor assemblies on both sides of unit.
3. Internal Insulation: Fibrous-glass duct lining, comply with ASTM C 1071, Type II, applied on furnace and fan sections only.

    a. Thickness: Minimum 1 inch.
    b. Insulation Adhesive: Comply with ASTM C 916, Type I.
    c. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.

4. Finish: Galvanized steel.

D. Supply-Air Fan:

1. Fan Type: DWDI forward-curve centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft.
2. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.
3. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with elastomeric isolators.
4. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.

E. Air Filters:

1. Comply with NFPA 90A.
2. Cleanable Filters: 2-inch- thick, cleanable metal mesh.

F. Dampers:

1. Outdoor-Air Damper: Galvanized-steel, opposed-blade dampers with vinyl blade seals and stainless-steel jamb seals, having a maximum leakage of 10 cfm/sq. ft. of damper area, at differential pressure of 2-inch wg.
2. Damper Operator: Direct coupled, electronic with spring return or fully modulating as required by the control sequence.

G. Direct-Fired Gas Furnace:

1. Description: Factory assembled, piped, and wired; and complying with ANSI Z83.4, "Direct Gas-Fired Make-Up Air Heaters"; ANSI Z83.18, "Direct Gas-Fired Industrial Air Heaters"; and NFPA 54, "National Fuel Gas Code."
2. Burners: Cast-iron burner with fixed stainless-steel profile plates. Air from the occupied space shall not be allowed to pass through the burner.

    a. Control Valve: Modulating, turndown ratio as scheduled on the Drawings.

b. Fuel: Natural gas.
c. Pilot: Electrically ignited by hot-surface ceramic igniter or electric spark ignition.

3. Safety Controls:

a. Purge-Period Timer: Automatically delays burner ignition and bypasses low-limit control.
b. Airflow Proving Switch: Dual pressure switch senses correct airflow before energizing pilot and requires airflow to be maintained within minimum and maximum pressure settings across burner.
c. Manual-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
d. Gas Train: Redundant, automatic main gas valves, electric pilot valve, electronic-modulating temperature control valve, main and pilot gas regulators, main and pilot manual shutoff valves, main and pilot pressure taps, to comply with AXA XL GAPS (formerly IRI) requirements.
e. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.
f. Control Transformer: Integrally mounted 24-V ac.

H. Controls:

1. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.
2. Control Panel: Recessed, with trim ring, remote panel, with engraved plastic cover, and the following lights and switches:

a. On-off-auto switch.
b. Automatic changeover.
c. Supply-fan operation indicating light.
d. Heating operation indicating light.
e. Damper position potentiometer.
f. Thermostat.
g. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
h. Safety-lockout indicating light.

3. Refer to Division 23 Section "Temperature Controls" for control equipment and sequence of operation.
4. Fan Control: Refer to Division 23 Section “Temperature Controls” and the Sequence of Operation indicated on the Drawings for exhaust fan controls.
5. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.
6. Outdoor-Air and Fan-Discharge Damper Control, 100 Percent Outdoor-Air Units:

a. Outdoor-air damper shall open when supply fan starts, and close when fan stops.

7. Temperature Control: Operates gas valve to maintain supply-air or room temperature.

a. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in fan outlet.

8. DDC: Stand-alone control module for link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Division 23 Section "Temperature Controls."

a. Provide start and stop interface relay, and relay to notify DDC system alarm condition.
b. Provide hardware interface or additional sensors as follows:

1) Room temperature.
2) Discharge-air temperature.
3) Furnace operating.

2.02 ACCESSORIES

A. Discharge head: The manufacturer shall provide a 1-, 3- or 4-way discharge head (as shown on drawings) for control of discharge airflow.

2.03 MOTORS

A. Comply with requirements in Division 20 Section "Motors."

2.04 CAPACITIES AND CHARACTERISTICS

A. Refer to Schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation of direct-fired H&V units.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine equipment supports for suitable conditions where rooftop H&V units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."

B. Hoist, transport, and rig units or their shipping sections into position following procedures recommended by manufacturer.

C. Install units level and plumb, maintaining manufacturer's recommended clearances. Install according to AHRI Guideline B.

D. Install suspended units from spring hangers with minimum 1-inch static deflection; refer to Division 20 Section "Mechanical Vibration Controls."

E. Install controls and equipment shipped by manufacturer for field installation with direct-fired H&V units.

3.03 CONNECTIONS

A. Piping Connections: Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.

1. Gas Piping: Comply with requirements in Division 23 Section "Fuel Gas Piping." Connect gas piping with shutoff valve and union and with sufficient clearance for burner removal and service. Provide CSA-approved flexible connectors.

B. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to direct-fired H&V units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Duct Accessories."

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for visible damage to furnace combustion chamber.
2. Inspect casing insulation for integrity, moisture content, and adhesion.
3. Verify that clearances have been provided for servicing.
4. Verify that controls are connected and operable.
5. Verify that filters are installed.
6. Purge gas line.
7. Inspect and adjust vibration isolators .

8. Verify bearing lubrication.
9. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
10. Adjust fan belts to proper alignment and tension.
11. Start unit according to manufacturer's written instructions.
12. Complete startup sheets and attach copy with Contractor's startup report.
13. Inspect and record performance of interlocks and protective devices; verify sequences.
14. Operate unit for run-in period recommended by manufacturer.
15. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:

    a. Measure gas pressure on manifold.
    b. Measure combustion-air temperature at inlet to combustion chamber.
    c. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

16. Calibrate thermostats.
17. Adjust and inspect high-temperature limits.
18. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. Measure and record airflow. Plot fan volumes on fan curve.
21. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:

    a. High-limit heat.
    b. Alarms.

22. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace malfunctioning components that do not pass tests and inspections and retest as specified above.

D. Prepare written report of the results of startup services.

3.05 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain direct-fired H&V units.

END OF SECTION 23 73 39

SECTION 26 00 10 - ELECTRICAL GENERAL REQUIREMENTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.02 SUMMARY

A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.03 REFERENCES

A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. ANSI - American National Standards Institute; www.ansi.org.
2. ASTM - ASTM International; www.astm.org.
3. CSI - Construction Specifications Institute (The); www.csiresources.org.
4. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
6. NEC - National Electrical Code
7. NECA - National Electrical Contractors Association; www.necanet.org.

    a. NECA 1-2000, “Practices for Good Workmanship in Electrical Contracting (ANSI).”

8. NEMA - National Electrical Manufacturers Association; www.nema.org.
9. NETA - InterNational Electrical Testing Association; www.netaworld.org.
10. UL - Underwriters Laboratories Inc.; www.ul.com.

1.04 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test, and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.

1. Contract Documents are complementary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
2. The Contractor understands that the work herein described shall be complete in every detail.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State, and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.

1. Notify the Architect/Engineer if revisions to the Drawings or Specifications are required to conform to applicable ordinances, codes, or regulations. Identify the cost associated with these revisions in the bid.

C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county, and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Avoid interference with the work of other trades. Remove and relocate any work which in the opinion of the Owner's Representatives causes interference.

1.05 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals, and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules, and regulations.

B. Comply with rules of local utility companies. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets, and meters which will be required and include the cost of all such items and all utilities costs in proposal.

C. All work shall be executed in accordance with the rules and regulations outlined in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction that exceed code requirements, the Drawings and/or Specifications shall govern.

1.06 DRAWINGS

A. The Drawings show the location and general arrangement of equipment, electrical systems, and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes, and accessories as may be required to meet such conditions.

C. Deviations from the Drawings, apart from minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades, and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.07 MATERIAL AND EQUIPMENT MANUFACTURERS

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new, be standard products of manufacturers regularly engaged in the production of electrical equipment and be of the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

C. Where existing equipment is modified to include new switches, circuit breakers, metering, or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third-party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.08 INSPECTION OF SITE

A. Visit the site, examine, and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.09 ITEMS REQUIRING PRIOR APPROVAL

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information, and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

A. Submit project-specific submittals for review in compliance with Division 1.

B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.

C. If deviations (not substitutions) from the Contract Documents are deemed necessary by the Contractor, the details of such deviations, the reason for the deviation, and the resulting changes shall be included with the submittal for approval.

E. Submit for approval shop drawings for electrical systems or equipment indicated in other sections of electrical specs. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures).

1.11 COORDINATION DRAWINGS

A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.

B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manual shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:

1. Routine maintenance procedures.
2. Trouble-shooting procedures.
3. Contractor's telephone numbers for warranty repair service.
4. Submittals.
5. Recommended spare parts list.
6. Names and telephone numbers of major material suppliers and subcontractors.
7. System schematic drawings on 8-1/2" x 11" sheets.

1.13 RECORD DRAWINGS

A. Submit record drawings in compliance with Division 01.

B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be marked with a contrasting color so the marks are readily apparent.

C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked-up field documents shall be available for review by the Architect, Engineer, and Owner at their request during construction.

1.14 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 4 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.

D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 WARRANTY

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship, or failure to follow the contract documents.

B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.

C. File with the Owner all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.17 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions; and to maintain the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 INSTALLATION OF EQUIPMENT

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.

B. Device Location:

1. Allow for wiring devices, control devices, and fire alarm devices to be relocated within a 10’ radius to accommodate final coordination with furnishings and other finish elements. Devices relocated prior to installation shall be done without additional cost to the project.

3.03 WORK IN EXISTING BUILDINGS

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

C. Consult with the Owner’s Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

3.04 TEMPORARY SERVICES

A. Provide and remove upon completion of the project, following the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.

3.05 CHASES AND RECESSES

A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.06 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

A. Refer to General Conditions for requirements.

B. All cutting, patching, and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.07 EXCAVATION AND BACKFILLING

A. Provide all excavation, trenching, tunneling, dewatering, and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.

B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.

C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

D. Backfill all excavations inside building, under drives, and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen excavated material in such a way as to prevent settling.

3.08 EQUIPMENT CONNECTIONS

A. Make connections to equipment and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.09 CLEANING

A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.

B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.10 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Equipment and materials shall be protected from theft, injury, or damage.

B. Protect conduit openings with temporary plugs or caps.

C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.11 EXTRA WORK

A. For additional electrical work which may be proposed or requested, furnish an itemized cost breakdown of material and labor required to complete the work. Proceed only after receiving a written authorization.

B. Before providing an itemized break-down for additional electrical work, submit unit prices for the following items: 1/2", 3/4", 1", 1-1/2" EMT conduit; #12, #10, #8, #6, #2 building wire; duplex receptacles, GFCI receptacles, data box and raceway, fire alarm audible/visual notification appliance and visual notification appliance, clocks and speakers, and other common electrical work which may be anticipated for any future revisions. These unit costs, once agreed to, shall be applied to additions and deducts for all project change orders.

3.12 DRAWINGS AND MEASUREMENTS

A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION 26 00 10

SECTION 26 05 19 - CONDUCTORS AND CABLES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:

1. Building wires and cables rated 600V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
2. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.03 SUBMITTALS

A. Field Quality-Control Test Reports

B. Submit letter of compliance (intent) for general building wire and cable. Provide product data for the following:

1. Metal-Clad Cable, Type MC
2. Mineral Insulated Cable, Type MI
3. 2- Hour Fire Rated Mc Power Cable

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:

1. Type THHN/THWN-2: Comply with UL 83.
2. Type THW/THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
3. Type XHHW-2: Comply with UL 44.

2.02 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

1. Allowed only for conductors used in feeders 100A and larger.

B. Manufacturers:

1. General Cable
2. Southwire

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.

E. Conductor Insulation:

1. Type XHHW-2: Comply with UL 44.

2.03 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers:

1. AFC Cable Systems
2. Alpha Wire Company
3. American Bare Conductor
4. Belden
5. Encore
6. General Cable
7. Okonite
8. Service Wire Co.
9. Southwire Company

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multi-circuit with color-coded conductors for branch circuit distribution.

2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors:

1. Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
2. Aluminum, complying with ASTM B 800 and ASTM B 801 for conductors #1 AWG and larger.

F. Ground Conductor: Insulated. Ground conductor sized as indicated on drawings (reduced ground conductor is not acceptable).

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Steel or Aluminum, interlocked.

I. Jacket: PVC applied over armor.

2.04 2-HOUR FIRE RATED MINERAL INSULATED CABLE, TYPE MI

A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V.

B. Manufacturers:

1. KME America
2. Pentair
3. Watlow Electric Manufacturing

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. UL 2196 for fire resistance.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multi-circuit with color-coded conductors.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper.

F. Insulation: Compressed magnesium oxide.

G. Sheath: Copper.

2.05 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Refer to application schedule on the drawings

B. If providing aluminum feeders, contractor is responsible for providing correct feeder, equipment ground and conduit size based on voltage drop and any de-rating required.

C. Feeders and Branch Circuits: Solid or stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

D. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).

E. Use conductor not smaller than 14 AWG for control circuits,

F. Where equipment is listed for use with copper conductors only, use copper conductors for the entire length of feeder.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Refer to application schedule on the drawings

B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.

C. Fire Alarm Circuits: Type THHN/THWN-2, in raceway.

D. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.

E. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

H. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.

I. Neatly train and lace wiring inside boxes, equipment, and panelboards.

J. Provide a separate neutral conductor for each circuit unless multi-wire branch circuits are specifically indicated on the drawings.

K. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable. Neutral conductors shall be considered current carrying conductors.

L. Type MC cable shall be supported and secured at intervals not exceeding 4'-0" in new construction

M. AC/MC cable shall not be used for home runs to receptacle or distribution panels.

N. Where AC/MC cable is permitted by the specifications, AC/MC cable shall not be bundled.

O. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.

P. Do not route conductors across roof without prior approval from engineer.

Q. Install and terminate power cable for variable frequency- controlled motors according to cable manufacturer’s recommendations.

R. Install fire resistive cable assemblies (Type MI cable and/or fire rated MC cable) in accordance with the manufacturer’s instructions and the product UL listing.

1. Do not paint fire resistive cable assemblies.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
2. Use compression type terminations for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. Clean conductor surfaces before installing lugs and connectors.

E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.

G. Use piercing connector with insulating covers for conductor splices and taps, 8 AWG and larger only for taps to existing feeders. Do not use piercing connectors in new construction.

H. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.

I. Use insulated spring wire connectors with plastic caps (wire nuts) for copper conductor splices and taps, 10 AWG and smaller. Push-in style connectors are not permitted.

J. Provide lugs suitable for bussing and conductor material used.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 33 "Raceways and Boxes."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping".

3.08 FIELD QUALITY CONTROL

A. Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"

1. Description: Test all feeders rated 100 A and above.
2. Visual and Mechanical Inspection

    a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
    b. Test cable mechanical connections with an infrared survey.
    c. Check cable color-coding against project Specifications and N.E.C. requirements.

3. Electrical Tests

    a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
    b. Perform continuity test to insure proper cable connection.

4. Test Values

    a. Minimum insulation resistance values shall be not less than fifty mega-ohms.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements”.
2. Division 26 Section “Conductors and Cables”.

1.03 REFERENCES

A. ASTM B 3: Specification for Soft or Annealed Copper Wire.

B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.

C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.

E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

F. IEEE 142: Grounding of Industrial and Commercial Power Systems.

G. IEEE 837: Qualifying Permanent Connections Used in Substation Grounding.

H. IEEE 1100 – 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.

I. IEEE C2: National Electrical Safety Code.

J. NETA MTS – 2001: Maintenance Testing Specifications.

K. NFPA 70: National Electrical Code.

L. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.

M. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.

N. UL 467: Grounding and Bonding Equipment.

O. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

P. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 26 “Electrical General Requirements”.

B. Accurately record actual locations of grounding electrodes and connections to building steel.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Refer to specification section “Electrical Testing.”

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

D. Comply with ANSI/TIA/EIA-607 “Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications”.

E. Comply with ANSI/IEEE 1100 -1992 “Powering and Grounding Sensitive Electronic Equipment”.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors and Cables:

a. Refer to Division 26 Section “Conductors and Cables”.

2. Grounding Rods:

a. American Electric-Blackburn.
b. Apache Grounding/Erico Inc.
c. Chance/Hubbell.

3. Mechanical Connectors:

a. American Electric-Blackburn.
b. Burndy.
c. Chance/Hubbell.

4. Exothermic Connections:

a. Cadweld.

5. Compression-type Connectors:

a. Burndy HyGround
b. Blackburn EZ Ground.
c. Panduit.

2.02 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."

B. Material: Aluminum, copper-clad aluminum, and copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Grounding Electrode Conductors: Stranded cable.

E. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

F. Copper Bonding Conductors: As follows:

1. Bonding Conductor: Stranded copper conductor; size per the NEC.
2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.
3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.

G. Ground Conductor and Conductor Protector for Wood Poles: As follows:

1. No. 4 AWG minimum, soft-drawn copper conductor.
2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.

H. Electrical Grounding Busbar

1. 24” (min) x 2” x ¼” tin plated, copper busbar with two rows of ¼” x 20 tapped holes 1” on center.

I. Telecommunications Main Grounding Busbar (TMGB)

1. 48” (min) x 4” x ¼” tin plated, copper busbar with three rows of ¼ x 20 tapped holes 1” on center.

J. Telecommunications Grounding Busbar (TGB)

1. 12” (min) x 2” x ¼” tin plated, copper busbar with two rows of ¼ x 20 tapped holes 3” on center.

K. N. Telecommunications Bonding Backbone (TBB)

1. Minimum No. 2 AWG insulated stranded copper.

L. Telecommunications Bonding Conductors

1. Minimum No. 6 AWG insulated stranded copper.

M. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.03 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.

D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.

1. Size: 5/8 in diameter.
2. Length: 120 inches.

PART 3 EXECUTION

3.01 EQUIPMENT GROUNDING

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

C. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

D. In raceways, use insulated equipment grounding conductors.

E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.

F. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

G. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

H. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a separate equipment grounding conductor with supply branch-circuit conductors. Bond pole and foundation reinforcing steel to equipment ground conductor.

J. Verify specific equipment grounding requirements with the manufacturer's recommendations.

3.02 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations

1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Connections shall be non-reversible. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.03 INSTALLATION

A. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system Grounding electrodes to be interconnected include:

1. Ground rods.
2. Metal water service pipe.

B. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Verify that final backfill and compaction has been complete before driving ground rods.
2. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds or non-reversing compression-type connectors, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.

1. Aluminum and copper-clad aluminum conductors shall not be used in direct contact with masonry, within 18 inches of the earth, or where subject to corrosive conditions.

D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors or non-reversing compression-type connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

E. Metal Water Service Pipes in direct contact with the earth for 10 feet: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to all metal water service entrances to building including fire protection water service entrance. Connect grounding conductors to metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

H. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers and uninterruptible power supplies to grounding electrodes per NFPA 70.

I. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

J. Grounding Bus:

1. Install grounding bus in the locations listed below and elsewhere as indicated:

    a. Electrical equipment rooms.
    b. Telephone equipment rooms.
    c. Rooms housing service equipment.

2. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.

K. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.

L. Bond together metal building elements not attached to grounded structure; bond to ground.

3.04 TELECOMMUNICATIONS GROUNDING

A. Telecommunications Grounding System: The telecommunications grounding system shall consist of:

1. Telecommunications Main Grounding Busbar (TMGB) located in the main telecommunications room near the telecommunications service entrance. Bond to the main building electrical grounding electrode system via a No. 3/0 AWG copper ground conductor.
2. A Telecommunications Grounding Busbar (TGB) in each telecommunications room, cabinets, etc.

3. A Telecommunications Bonding Backbone (TBB) tying together the TMGB and each TGB.
4. Bonding of all equipment racks, raceways, non-current carrying metallic equipment and surge protection devices within the telecommunications room to the TGB's or TMGB using approved bonding conductors. Each piece of equipment shall be bonded individually directly to the ground bus.

B. All bonding connections shall be installed at an accessible location for inspection and maintenance.

C. All telecommunications bonding connections shall be of an approved mechanical type connection. Do not use exothermic welds unless specifically indicated on the Drawings.

D. The physical routing shall, in general, follow the same path as the backbone cable system.

E. Bond each TGB directly to the building steel with a No. 6 AWG conductor.

F. Do not use TGB's as a power system ground connection unless specifically noted on the Drawings.

G. All bonding connectors and conductors shall be UL listed for the purpose intended.

H. Mount TMGB and TGB bus to backboard or wall using 2" standoff insulators.

I. Individually bond each piece of non-current carrying metallic equipment in the Telecommunications Room to the TGB.

J. Install continuous cable from the TMGB to the furthest TGB. Bond all TGB's to TBB with bare No. 3/0 AWG copper ground conductor and T-tap grounding hardware.

3.05 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"

1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.
2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

    a. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
    b. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

c. Perform tests, by the fall-of-potential method according to IEEE 81. Instrumentation utilized shall be as defined in Section 12 of IEEE 81 and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that curves flatten in the 62% area of the distance between the item under test and the current electrode.

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

   a. Equipment Rated 500 kVA and Less: 10 ohms.
   b. Equipment Rated 500 to 1000 kVA: 5 ohms.
   c. Equipment Rated More Than 1000 kVA: 3 ohms.
   d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
   e. Manhole Grounds: 10 ohms.
   f. The telecommunications grounding system shall have a maximum resistance of 1 ohm as measured from the TMGB ground to earth ground.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.06 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.05 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International..
b. B-Line, by Eaton..
c. GS Metals Corp.
d. Pentair Electrical & Fastening Solutions.
e. Thomas & Betts Corporation.

f. Unistrut; a part of Atkore International.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.
b. B-Line by Eaton.
c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti Inc.
2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) B-Line by Eaton.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.03 ROOF MOUNTED CONDUIT AND EQUIPMENT SUPPORTS

A. General: Shop- or field- fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted conduit and equipment.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-Line by Eaton; Dura-Blok.

2. MIRO Industries.
3. Pentair Electrical & Fastening Solutions; Caddy Pyramid.
4. Pipe Pier Support Systems; Pipe Piers.

C. Adjustable Compact Stand: Recycled rubber base unit with integral threaded coupling capable of accepting 3/8-16 threaded rod, or 1-5/8 inch by 1-5/8 inch metal strut and various supporting elements.

D. Multiple-Conduit and Equipment Stand: Assembly of bases, vertical and horizontal members, and conduit supports, for roof installation without membrane penetration.

1. Bases: One or more adjustable compact stand bases.
2. Vertical Members: Two or more protective-coated-steel channels.
3. Horizontal Member: Protective-coated-steel channel.
4. Supports: Standard strut clamps, hangers, and accessories.

2.04 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry." Plywood sheets shall be free of all voids. Plywood shall have a minimum of two coats of fire-resistant, non-conducting paint applied to all sides of all sheets. Provide flush hardware and supports to mount plywood to wall. The provided hardware shall have sufficient strength to carry all anticipated loads including, but not limited to cabling, cable management and equipment racks.

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with:

a. Two-bolt conduit clamps
b. Single-bolt conduit clamps

c. Single-bolt conduit clamps using spring friction action for retention in support channel.

D. Support single runs of MC cable using spring-steel clamps from suspended ceiling hangers, hanger wire or building structure at intervals not to exceed three feet. Do not support MC cable from ceiling grid.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel:

    a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
    b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
    c. Spring-tension clamps.

7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel support systems attached to substrate.

E. Slotted support systems applications:

1. Indoor dry and damp Locations: Painted Steel
2. Outdoors and interior wet locations: Galvanized Steel
3. Corrosive Environments, including pool equipment rooms: Nonmetallic

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

G. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

H. Obtain permission from Architect/Engineer before using powder-actuated anchors.

I. Obtain permission from Architect/Engineer before drilling or cutting structural members.

J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

K. Install surface-mounted cabinets and panelboards with minimum of four anchors.

L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

M. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

N. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 INSTALLATION OF ROOF MOUNTED SUPPORTS

A. Install in accordance with manufacturer’s instructions.

B. If gravel top roof, gravel must be removed around and under support.

C. Consult roofing manufacturer for roof membrane compression capacities. If required, a compatible sheet of roofing material (rubber pad) may be required under rooftop support to disperse concentrated loads and add further membrane protection.

D. Utilize properly sized clamps and accessories to suit conduit sizes.

E. Provide vertical steel channel members as required for elevated conduit supports where required for clearances, coordination with other roof mounted systems or derating.

3.05 CONCRETE BASES

A. Provide concrete bases for all floor mounted electrical equipment.

B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.

C. Base/Pad Construction:

1. Construct per manufacturer's recommendations for particular equipment, including suggested piers and dowel rods.
2. Interior concrete bases shall have a minimum depth of 4" unless other indicated or recommended by the manufacturer.
3. Exterior concrete bases shall have a minimum depth of 8" unless other indicated or recommended by the manufacturer.
4. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.

D. Anchor equipment to base per both supports and equipment manufacturer's instructions.

E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of the base.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

3.06 BACKBOARDS

A. A minimum of two walls (or as indicated on drawings) shall be covered with plywood backboards to a minimum 8'-6" above finished floor in all Telecommunication Rooms and similar spaces and as indicated on Drawings.

B. Securely fasten backboard to wall using appropriate hardware and mount at all four corners, minimum. Securely fasten backboard to wall-framing members (studs).

C. Provide adequate backboard space to allow a clean and workable arrangement for telephone and data connections.

3.07 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section, “Underground Ducts and Raceways for Electrical Systems” for exterior duct banks, manholes and underground utility construction.

2. Division 07 Section, “Penetration Firestopping” for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
4. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. LFNC: Liquidtight flexible nonmetallic conduit.

G. RNC: Rigid nonmetallic conduit.

H. PVC: Polyvinyl Chloride.

I. HDPE: High Density Polyethylene.

J. RTRC: Reinforced Thermosetting Resin Conduit

1.04 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.06 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube Triangle Century.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. International Metal Hose.
6. Electri-Flex Co
7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.
9. Maverick.
10. O-Z Gedney; unit of General Signal.
11. Wheatland.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. PVC-Coated Steel Conduit: PVC-coated IMC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: ANSI C80.3.

G. FMC: Zinc-coated steel or Aluminum.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Fittings for EMT: Steel, set screw or compression type.
2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

2.02 FIRE ALARM EMT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube Triangle Century.

B. EMT conduit with bright red topcoat; Fire Alarm EMT.

C. EMT and Fittings: ANSI C80.3.

2.03 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe and Plastics Group.
6. Condux International.
7. ElecSys, Inc.
8. Electri-Flex Co.
9. Integral.
10. Kor-Kap.
11. Lamson and Sessions: Carlon Electrical Products.
12. Manhattan/CDT/Cole-Flex.
13. RACO; Division of Hubbell, Inc.
14. Scepter.
15. Spiralduct, Inc./AFC Cable Systems, Inc.
16. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.

G. RTRC: Comply with UL 2515A and NEMA TC 14.

2.04 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Hinged type.

F. Finish: Manufacturer's standard enamel finish.

2.05 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating and confirm final finish with architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
b. Thomas & Betts Corporation.
c. Walker Systems, Inc.; Wiremold Company (The).
d. Wiremold Company (The); Electrical Sales Division.
e. Mono-Systems, Inc.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell, Inc.; Wiring Device Division.
b. Carlon Electric Products.
c. Panduit Corporation.
d. Walker Systems, Inc.; Wiremold Company (The).
e. Wiremold Company (The); Electrical Sales Division.
f. Mono-Systems, Inc.

C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.06 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2.07 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with ANSI/SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC", “COMMUNICATIONS” or as indicated for each system service.
6. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell: Quazite
b. Armorcast Products Company.
c. Carson Industries LLC.
d. CDR Systems Corporation.
e. NewBasis.
f. Christy Concrete Products.

2.08 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.09 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Provide raceways in interior and exterior locations in accordance with the “Raceway Application Matrix” included on the drawings.

B. Boxes and Enclosures, Exterior Aboveground: NEMA 250, Type 3R.

C. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.

D. Minimum Raceway Size: 3/4-inch trade size.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. Do not install aluminum conduits in contact with concrete.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Install temporary closures to prevent foreign matter from entering raceways.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

J. Support conduit within 12 inches of enclosures to which attached.

K. Raceways Embedded in Slabs:

1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.
2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
4. Space raceways laterally to prevent voids in concrete.

5. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
7. Conduits shall run flat. Do not allow conduits to cross.
8. Change from non-metallic raceway to rigid steel before turning up out of the concrete and rising above the floor.

L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

U. Communications and Signal Cabling Systems Raceways: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

1. Electrical condulet (LB's) are not permitted.
2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
3. Conduits shall contain no continuous sections longer than 150 ft. without a pull point/box.
4. Conduit for fiber cabling shall have a bend radius of at least 10 times the internal diameter.
5. Conduit for copper cabling less than 2" shall have a bend radius of at least 6 times the internal diameter. Conduit for copper cabling 2" and larger shall have a bend radius of at least 10 times the internal diameter.
6. All conduit ends shall have an insulated bushing.

V. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

W. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

X. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Provide cover clips to cover space between connecting pieces.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.

EE. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

FF. Do not route feeders across roof.

GG. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, 42” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Through-Penetration Firestop Systems."

3.08 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.09 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PART 2 – PRODUCTS

2.1 RACEWAY AND CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2-inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical- resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Machine preprinted black printing on clear background, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend, machine printed by thermal transfer or equivalent process.

2.4 NAMEPLATES AND SIGNS

A. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.

B. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.

C. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.

D. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.

3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
4. Not less than 6 inches wide by 4 mils thick.
5. Compounded for permanent direct-burial service.
6. Embedded continuous metallic strip or core.
7. Printed legend indicating type of underground line.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

C. Stenciled Legend: In non-fading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - PART 3 – EXECUTION

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

F. Circuits with More Than 600 V: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches high, stenciled with paint at 10-foot intervals over a continuous, painted orange background. Identify the following:

1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to conduits concealed within wall.
3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
4. Entire surface of exposed conduits.

G. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime surfaces using type of primer specified for surface.
3. Apply one intermediate and one finish coat of enamel.

H. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self- adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

I. Circuit Identification on Device Plates.

1. Identify circuits feeding receptacles with the designation of the panelboard and the circuit number in preprinted black type on clear background on the outside face of each device cover plate.
2. In mechanical, technology closets, electrical rooms and industrial type spaces, provide typed self- adhesive plastic labeling on outside of cover-plate to indicate the circuit number.

J. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
2. Concealed Boxes: Plasticized card-stock tags.
3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

K. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

L. Underground-Line Warning Tape: During backfilling of trenches, install continuous underground-line warning tape directly above line at 6 to 8-inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16-inches overall.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 20-foot maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and

system voltage. Also include panel identification, circuit number(s) and installing company name. System legends shall be as follows:

1. Emergency Power (red cover and box).
2. Power.
3. UPS (orange cover).
4. Fire Alarm (red cover and box).
5. Low Voltage (blue cover).
6. Temperature Control (purple cover).

C. Color-Coding of Secondary Phase Conductors: Use the following colors for service feeder and branch- circuit phase conductors:

1. 208/120-V Conductors:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White.
   e. Ground: Green.

2. 480/277-V Conductors:

   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral: Slate/Gray.
   e. Ground: Green.

3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

   a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
   b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

D. Provide labelling of each independent, conductors at 50’ maximum centers, label at equipment and label at bus bars. Separate ground conductors routed concealed within conduit shall have conduit labels to identify the grounding conductor equipment or grounding/bonding location.

1. Indicate what equipment is fed or where the equipment is fed from on the label.

2. At service grounding bus bar, label service grounding electrode conductor= at service entrance ground and label the equipment served by each equipment ground conductor.

E. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
4. Provide wire circuit number at all termination points.

F. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

H. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer, load shedding and multiple services.

I. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Electrical switchgear and switchboards.
4. Electrical substations.
5. Emergency system boxes and enclosures.
6. Motor-control centers.
7. Disconnect switches.
8. Enclosed circuit breakers.

9. Motor starters.
10. Push-button stations.
11. Boiler shut offs.
12. Power transfer equipment.
13. Contactors.
14. Remote-controlled switches.
15. Dimmers.
16. Control devices.
17. Transformers.
18. Power-generating units.
19. Clock/program master equipment.
20. Call system master station.
21. Fire alarm control panel.
22. Security-monitoring master station or control panel.

END OF SECTION 26 05 53

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.03 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.145.

1.04 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.
2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.03 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.04 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.05 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Match airport standards for color of label and lettering. Minimum letter height shall be 3/8 inch.

B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.06 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb, minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.07 WIRING DEVICE IDENTIFICATION

A. Description: Self-adhesive label with black upper case letters on clear polyester label, font size 7.

PART 3 EXECUTION

3.01 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders More Than 400 A: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:

1. Fire Alarm System: Red.
2. Security System: Blue and yellow.
3. Telecommunication System: Green and yellow.
4. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.

E. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.

F. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.
b. Outdoor Equipment: Stenciled.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled: If included on project. All items may not be on project.

a. Panelboards, electrical cabinets, and enclosures.
b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.
d. Transformers.
e. Electrical substations.
f. Emergency system boxes and enclosures.
g. Motor-control centers.
h. Disconnect switches.
i. Enclosed circuit breakers.
j. Motor starters.
k. Push-button stations.
l. Power transfer equipment.
m. Contactors.
n. Remote-controlled switches, dimmer modules, and control devices.
o. Battery inverter units.
p. Battery racks.
q. Power-generating units.
r. Voice and data cable terminal equipment.
s. Master clock and program equipment.
t. Intercommunication and call system master and staff stations.
u. Television/audio components, racks, and controls.
v. Fire-alarm control panel and annunciators.
w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.

x. Monitoring and control equipment.
y. Uninterruptible power supply equipment.
z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
aa. Breakers or switches at distribution panels.

K. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.

3.02 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location:

1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.

C. Apply identification devices to surfaces after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Grounded Conductor (Neutral): White.

3. Colors for 480/277-V Circuits:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Ground Conductor (Neutral): Grey.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

I. Label information arrangement for 3 lines of text.

1. Line one shall describe the building number and room name. Line one example: “BLD XXX – RM XXX”
2. Line two shall describe the panel or equipment. Line two example: “DPXX,” RPXX,” “TXX,” “EFXX,” etc.
3. Line three shall describe the first disconnecting means feeding this panel or equipment. Line three example: “Fed from DPXX,” “Fed from RPXX,” etc.
4. Line four indicates that location of the disconnecting means as identified in line four. Line four example: “First Floor Elect. Rm #XXX.”
5. Line five shall describe voltage, phase, and wire. Line five example: “120/208V 3PH 4W”etc.

J. Examples:

BLG 100 – RM T1002 LP15 FED FROM DP2A ROOM 100 120/208V 3PH 4W	EF-1 FED FROM LP15 MECHANICAL ROOM F101	EMERGENCY POWER BLG 100 – RM F1008 UPS5 LP22 A FED FROM GDP 1 ROOM 100 120/208V 3PH 4W

K. Fusible Enclosed Switches and Distribution Equipment: Install self-adhesive vinyl label indicating fuse rating and type on the outside of door on each fused switch.

L. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

M. Degrease and clean surface to receive nameplates.

N. Install nameplate and labels parallel to equipment lines.

O. Secure nameplate to equipment front using screws.

P. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

Q. Identify conduit using field painting where required.

R. Paint red colored band on each fire alarm conduit and junction box.

S. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION 26 05 53

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following lighting control devices:

1. Outdoor photoelectric control.
2. Occupancy sensors.
3. Outdoor motion sensors.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements”.
2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.
3. Division 26 Section "Lighting Control Systems" for programmable lighting systems.

1.03 REFERENCES

A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.

B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.

C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.

D. NFPA 70: National Electrical Code.

E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

F. UL 486B: Wire Connectors for Use with Aluminum Conductors.

G. UL 773: Plug-in, Locking Photocontrols for Use with Area Lighting.

H. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.

I. UL 917: Clock Operated Switches.

J. UL 1449: Surge Protective Devices.

K. UL 1598: Luminaires.

L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.04 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.

D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.

E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated including physical data and electrical performance.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Lighting plan showing location, orientation, and coverage area of each sensor.
2. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:

1. Description of operation and servicing procedures.
2. List of major components.
3. Recommended spare parts.
4. Programming instructions and system operation procedures.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.07 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate interface of lighting control devices with temperature controls specified in Division 23.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Division 26 Section “Electrical General Requirements”.

B. Store and protect products under provisions of Division 26 Section “Electrical General Requirements”.

PART 2 PRODUCTS

2.01 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.02 OUTDOOR PHOTOELECTRIC CONTROL

A. Manufacturers:

1. Intermatic, Inc.
2. Square D.
3. TORK.

B. General

1. Provide fully-gasketed, weathertight enclosure constructed of die cast zinc, with one-half inch conduit nipple for mounting purposes, and with positioning lug to permit full 360-degree adjustable orientation of photocell.
2. Provide hermetically-sealed, one-inch-diameter, cadmium sulphide photoelectric cell with manual, light level selector.
3. Provide photoelectric control suitable for an operating temperature range of minus 40 degrees F to plus 140 degrees F.

C. Description: Solid state, with SPST dry contacts rated for load, to operate connected load, relay, contactor coils, or microprocessor input, and complying with UL 773A.

1. Light-Level Monitoring Range: Adjustable turn-on range of 1 to 5 footcandle and adjustable turn-off range of 3 to 15 footcandle, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: Adjustable delay up to two minutes to prevent false operation.
3. Contacts: Normally closed, fail on.
4. Electrical: Provide photocell with operating voltage rated to switch the load directly unless otherwise indicated.
5. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
6. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.
7. Provide hermatically-sealed, one inch diameter, cadmium sulphide photoelectric cell with manual, 2 to 50 footcandle, light level selector.

2.03 OCCUPANCY SENSORS

A. General

1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer’s recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.

3. Provide occupancy sensors with a bypass switch to override the "ON" function in the event of sensor failure.
4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.

B. Wall Switch Passive Infrared Occupancy Sensor

1. Manufacturers:

   a. Perfect Sense – PS-PWS
   b. Wattstopper PW-100.
   c. Hubbell Building Automation SOM 101.
   d. Greengate OSW-P-0451-W.
   e. Sensorswitch WSD.
   f. Philips LRS2210.
   g. Leviton ODS10-IDW.

2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.

   a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
   b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
   c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes.
   d. Device Body: Finish selected by architect, plastic with momentary on/off override pushbutton designed to mount in a standard switch box with "decora" style switch plate.

3. Dual Level Switching: Provide occupancy sensor capable of controlling two switch legs independently where dual level switching is indicated.

   a. Manufacturers:

      1) Perfect Sense PWD.
      2) Wattstopper PW-200.
      3) Hubbell Building Automation SOM-102.
      4) Greengate OSW-P-0451-DMV.
      5) Sensorswitch WSD-2P.
      6) Philips LRS2215.
      7) Leviton ODSOD-IDW.

C. 360° Ceiling Mounted Dual Technology Occupancy Sensor

1. Manufacturers:

   a. Perfect Sense CDS.

b. Wattstopper DT 300
c. Hubbell Building Automation “OMNI-DT” Series.
d. Greengate OMC-DT-2000-R.
e. Sensorswitch CM-PDT-R.
f. Philips LRM2255.
g. Leviton OSC10-M0W.

2. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.

a. Housing: White, thermoplastic, tamper resistant ceiling mount.
b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
e. Manual override function.

D. 110° Wall Mounted Dual Technology Occupancy Sensor

1. Manufacturers:

a. Perfect Sense DTC.
b. Wattstopper DT-200
c. Hubbell Building Automation “LO-DT” Series.
d. Sensorswitch WV-PDT-R/WV-BR.
e. Philips LRM2265.
f. Leviton OSW12-M0W.

2. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.

a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 15 minutes.
d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
f. Manual override function.

E. 360° Ceiling Mounted Ultrasonic Occupancy Sensors

1. Manufacturers:

    a. Perfect Sense WDS.
    b. Wattstopper “WT” Series.
    c. Hubbell Building Automation “OMNI-US” Series.
    d. Greengate OPC-U-2000.
    e. Sensorswitch CM MPT-10.
    f. Philips LRM2255.
    g. Leviton OSC20-U0W.

2. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.

    a. Housing: White, thermoplastic, tamper resistant.
    b. Adjustments: Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 15 minutes.
    c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
    d. Manual override function.

F. 360° Ceiling Mounted Passive Infrared Occupancy Sensor.

1. Manufacturers:

    a. Perfect Sense CPS.
    b. Wattstopper CI-200.
    c. Hubbell Building Automation OMNI-IR.
    d. Greengate OMC-P-04500-R.
    e. Sensorswitch CM-9.
    f. Philips LRM2250.
    g. Leviton OSC04-I0W.

2. Description: Ceiling mounted, 360° coverage, infrared sensing occupancy sensor.

    a. Housing: White, thermoplastic, tamper resistant ceiling mount.
    b. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
    c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
    d. Manual override function.

G. Occupancy Sensor Control Units:

1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.

a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.
b. Occupancy sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.
c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.
f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

PART 3 EXECUTION

3.01 LIGHTING CONTACTOR INSTALLATION

A. Install lighting contactors as indicated on plan. Install at accessible locations. Switch controls where provided shall be no higher than 54" or lower than 48".

B. Demonstrate proper operation of all lighting control functions to the Owner and Engineer.

3.02 OUTDOOR PHOTOELECTRIC CONTROL INSTALLATION

A. Mount photocell on roof or parapet to ½" GRS conduit, supported to building structure below. Coordinate roof penetration with roofing contractor.

B. Install photoelectric control oriented in the northeast direction and not within any potential shadows.

C. Adjust photocell sensitivity and delay to meet owner's requirements. Multiple adjustments may be required, as needed.

3.03 OCCUPANCY SENSOR INSTALLATION

A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.

B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.

C. Locate sensors such that motion through open doors will not falsely activate sensors.

D. Do not locate ultrasonic sensors within six feet of supply air diffusers.

E. Locate infrared sensors to avoid obstructions.

F. Provide the services of a manufacturer's representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.

G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

3.04 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Conductors and Cables".

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."

B. Label time switches and contactors with a unique designation.

3.06 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION 26 09 23

SECTION 26 09 43 - LIGHTING CONTROL SYSTEMS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the design and installation programmable automatic lighting controls with all input and control devices necessary to meet the performance indicated on the contract drawings and this specification

B. Related Sections include the following:

1. Division26 Section "Lighting Control Devices" for time switches, photoelectric switches, occupancy sensors, and multi-pole contactors.
2. Division 26 Section “LED Interior Lighting” for luminaire specifications and accessories.

1.03 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. Lon Works: A control network technology platform for designing and implementing interoperable control devices and networks.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

D. RS-485: A serial network protocol, like RS-232, complying with TIA/EIA-485-A.

1.04 SUBMITTALS

A. Product Data: Indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature for all sensors, relays, dimming modules, control stations and other devices necessary for complete operation of the system

B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.

1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements for all system components requiring field installation.
2. Riser Diagram: Show interconnection between all system components.

    a. Identify complete data communication backbone and interconnection between sensors, relays, dimming modules control stations and other components.
    b. Identify typical room/area type configurations.
    c. Indicate interconnections with emergency egress lighting relays and transfer devices required.

3. Information Technology (IT) connection: Provide information pertaining to interconnection with facility IT networking equipment and third-party systems.
4. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).

5. Contractor startup and commissioning worksheet.

C. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

D. Submit qualifications of commissioning agent and draft functional test plans for review and approval.

E. Field quality-control test reports and commissioning reports at project closeout.

F. Software licenses and upgrades required by and installed for operation and programming of digital devices.

G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals. Include the following:

1. Software manuals.
2. Operation of adjustable zone controls.
3. Description of operation and servicing procedures.
4. List of major components and recommended parts.
5. System operation and integration instructions.

H. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer with total responsibility for compatibility of lighting control system components specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with NFPA 70.

E. Listed as qualified under Design Lights Consortium (DLC) Networked Lighting Control System Specification V2.0.

F. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.

G. Comply with ASHRAE 90.1 - 2013

1.06 COORDINATION

A. Coordinate lighting control components specified in this Section and with systems and components specified in other Sections to form an integrated interconnection of compatible components.

B. Match components and interconnections for optimum performance of lighting control functions.

C. Provide open protocol interface for interoperability with building automation system including status of each occupancy/vacancy sensor, control station, dimming module, relay, time schedule, display graphics and status of lighting controls by zone.

D. Coordinate lighting controls with devices specified in Division 26 Section “Lighting Control Devices”.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Batteries for all sensors and switches: Quantity equal to 10% percent of each type and size, but no fewer than 3 of each type and size.

1.09 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for five years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revise licenses for use of the software.

1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

1.10 SYSTEM COMMISSIONING

A. Provide the services of a third party, independent agent to perform functional testing and verification of the lighting control system to comply with the requirements of ASHRAE 90.1 – 2013.

B. Perform functional testing of all lighting control system operations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acuity nLight Air
2. Lutron Vive
3. WaveLinx – Eaton

2.02 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) system backbone for remote, time based and global operation between control zones.

a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible to minimize overall device count of system.
b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.”
c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone.

2. The system shall provide individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.
3. Lighting control zones shall be networked with a higher-level system backbone to provide time-based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality later.
5. System shall be capable of "out of box" sequence of operation for each control zone. Standard sequence is:

    a. All switches control all fixtures in a zone
    b. All occupancy sensors automatically control all fixtures in the control zone with a default timeout.

B. Wired Networked Control Zone Characteristics

1. All networked devices connected with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The "out of box" default sequence of operation is intended to provide typical sequence of operation to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:

    a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
    b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.
    c. Emergency egress devices shall be provided, and UL labeled by the lighting control manufacturer.

C. Wireless Networked Control Zone Characteristics

1. All wireless networked devices paired, meshed or grouped together shall automatically follow the "out of box" default sequence of operations.
2. Wireless network communication shall support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wall station signal.

3. To support the system architecture requirement for distributed intelligence, wireless network communication shall support communication of control signals from sensors and wall stations to networked luminaires and wireless load control devices, without requiring any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge or gateway.
4. All wireless communication shall be encrypted using at least 128-bit Advanced Encryption Standard (AES).
5. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:

    a. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss or interruption of power sensed via line voltage connections.

D. System Integration Capabilities

1. The system shall be capable of interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.

    a. Systems utilizing a third-party converter or systems that require a dedicated server to achieve integration are not acceptable.

2.03 SYSTEM SOFTWARE INTERFACES

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface

1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud-based server.

C. Visualization Interfaces

1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones

1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
2. Programming capabilities through the application shall include, but not be limited to, the following:

    a. Switch, occupancy and photo sensor group configuration
    b. Manual/automatic on modes
    c. Turn-on dim level
    d. Occupancy sensor time delays
    e. Dual technology occupancy sensors sensitivity
    f. Photo-sensor calibration adjustment and auto-setpoint
    g. Trim level settings

2.04 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller

1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall perform the following functions:

    a. Facilitation of global network communication between different areas and control zones.
    b. Time-based control of downstream wired and wireless network devices.
    c. Linking into an Ethernet network.
    d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
    e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.

3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
5. Device shall have a standard and astronomical internal time clock.
6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.

    a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
    b. BACnet/MSTP shall support 9600 to 115200 baud.

c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

2.05 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers

1. Wall switches & dimmers shall support the following device options:

a. Number of control zones: 1, 2 or 4. Gang multiple switches where more than 4 control zones are required in a single location under a single faceplate.
b. Control Types Supported: On/Off or On/Off/Dimming

2. Scene controllers shall support the following device options:

a. Number of scenes: 1, 2 or 4
b. Control Types Supported:

1) On/Off or On/Off/Dimming
2) Preset Level Scene Type
3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
4) Selecting a lighting profile to be run by the system's upstream controller to implement a selected lighting profile across multiple zones

3. Match color specified in Division 26 Section "Wiring Devices."
4. Integral green LED pilot light to indicate when circuit is on.
5. Internal white LED locator light to illuminate when circuit is off.
6. Networked switch stations shall have backlit buttons.
7. Wall Plates:

a. Single and multi-gang plates as specified in Division 26 Section "Wiring Devices."
b. Where multiple switches and/or dimmers are adjacent to each other, install a single cover plate. Provide separate boxes or barriers as required for the application.
c. Provide cover plates that are identical in material and dimension to standard single and double gang switch plates.
d. Verify back box requirements for multiple control points with manufacturer.

8. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

B. Wired Networked Auxiliary Input / Output (I/O) Devices

1. Auxiliary Input/output Devices shall be specified as an input or output device with the following options:

a. Contact closure input: Programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
b. 0-10V analog input: Programmable to function as a daylight sensor.
c. RS-232/RS-485 digital input: Supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current programmable to support all standard sequence of operations supported by system.

C. Wired Networked Occupancy and Photosensors

1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.
2. Sensing technologies that are acoustically passive, meaning they do not transmit sounds waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.
3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.
4. Sensor mounting type shall match project design requirements as shown on plans.

    a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.

5. The system shall support the following types of photocell-based control:

    a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.
    b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

D. Wired Networked Wall Switch Sensors

1. Wall switches sensors shall support the following device options:

    a. User Input Control Types Supported: On/Off or On/Off/Dimming
    b. Occupancy Sensing Technology: PIR only or Dual Tech
    c. Daylight Sensing Option: Inhibit Photosensor

E. Wired Networked Embedded Sensors

1. Embedded sensors shall support the following device options:

a. Occupancy Sensing technology: PIR only or Dual Tech
b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor

F. Distributed System Power, Switching and Dimming Controls

1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
2. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
3. Device shall be plenum rated.
4. Devices shall be UL Listed for load and load type as specified on the plans.

G. Wired Networked Luminaires

1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
2. Networked LED luminaire shall provide low voltage power to other networked control devices.
3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.

2.06 WIRELESS NETWORKED DEVICES

A. Wireless Networked Sensor Interface

1. The device shall be capable of broadcasting the following manual wall control commands: on, off, and adjust dim level.

B. Wireless Networked Light Controllers (No Sensor)

1. The wireless light controller shall be capable of providing continuous dimming and on/off control of one commercial light fixture including fluorescent, HID, induction and LEDs.
2. An external antenna attached to the luminaire shall not be allowed.

a. Each wireless light controller shall provide measurement capability of the amperage, voltage, wattage, and watt-hours of its controlled lighting.

C. Wireless Networked Digital Sensors

1. In addition to providing Wireless Networked Light Controllers functionality, also provides:

a. Integrated digital occupancy sensing and digital photocell sensor.

b. Sensor shall connect directly to the wireless light controller and shall be suitable for embedding into the enclosure of a luminaire.
c. Sensor shall have software-adjustable settings
d. Photocell shall be suitable for closed and open loop applications.

D. Wireless Network Communication Bridge

1. A communication bridge device shall be provided that interfaces with the System Controller via Owner's LAN connection and interfaces with wireless network.
2. Device shall be capable of communicating with a group of a minimum of 250 wireless networked devices and luminaires, to reduce the amount of communication bridges required in the system.

2.07 CONDUCTORS AND CABLES

A. General: All conductors and cables shall comply with the requirements of Division 26 Section "Conductors and Cables." Where cable is permitted to be installed exposed in ceiling space, provide plenum rated cable.

B. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG.

C. Classes 2 and 3 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 22 AWG.

D. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.

E. Digital and Multiplexed Signal Cables: As required by system manufacturer. Provide plenum rated cables where installed exposed in ceiling space.

PART 3 EXECUTION

3.01 WIRING INSTALLATION

A. The lighting control system shall be installed and connected as shown on the plans and as directed by the manufacturer.

B. Comply with NECA 1.

C. Wiring Method: Install wiring in raceways except where installed in accessible ceilings. Comply with Division 26 Sections "Conductors and Cables" and "Raceways and Boxes".

D. Where cables are installed in finished areas with exposed construction, conceal cables from view. Route at top of structural systems and conceal on top of structural members where possible. Where cable is exposed to view, provide raceway. As an alternative to raceway, provide cable that is factory colored to match exposed ceiling. Submit sample to Architect for approval.

E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

F. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

G. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

H. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes as per manufacturers' recommendations.

I. Identify components and power and control wiring according to Division26 Section "Electrical Identification."

J. Label each relay with a unique designation.

3.02 INSTALLATION REQUIREMENTS

A. Review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.

B. Install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals, plans and specifications.

C. Coordination with Owner's IT Network Infrastructure to secure all required network connections to the owner's IT network infrastructure. Provide the owner's representative with all network infrastructure requirements of the networked lighting control system. Provide the manufacturer's representative with all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.

D. Verify integration and interoperability scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.

3.03 SYSTEM STARTUP

A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.

1. Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.

B. System start-up and programming shall include:

1. Verifying operational communication to all system devices.
2. Programming the network devices into functional control zones to meet the required sequence of operation.
3. Programming and verifying all sequence of operations.
4. Customization of owner's software interfaces and applications.

C. Initial start-up and programming are to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.04 DOCUMENTATION

A. Submit software database file with desired device labels and notes completed.

B. Document the installed location of all networked devices, including networked luminaires. Provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components and equipment installation, including connections and assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Test for circuit continuity.
2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.06 SYSTEM COMMISSIONING

A. Facilitate the functional testing and verification of the lighting control system by an independent, third party commissioning agent.

B. Perform commissioning in the presence of the Owner's representative.

C. Submit functional test plan checklist signed by the commissioning agent.

3.07 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting programming functions and other system parameters and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to program, adjust, operate, and maintain lighting controls.

B. Demonstration shall be done only after initial system start-up setup has occurred and system is functioning properly.

C. Demonstration shall consist of a four-hour minimum session.

3.10 MANUFACTURER SUPPORT

A. Manufacturer telephone support shall be available at no cost to the Owner during the warranty period and shall include the following:

1. Assistance in solving programming or other application issues pertaining to the control equipment.
2. The manufacturer shall provide a toll-free number for direct technical support available 7 days a week, 24 hours a day.
3. A factory authorized technician shall be located within a 100-mile radius of the project site.

END OF SECTION 26 09 43

SECTION 26 09 99 - ELECTRICAL TESTING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements.”
2. Division 26 Section “Conductors and Cables.”
3. Division 26 Section “Grounding and Bonding.”
4. Division 26 Section “Panelboards.”
5. Division 26 Section “Motor Control Centers.”
6. Division 26 Section “Dry Type Transformers (600V and Less).”

1.02 SECTION INCLUDES

A. Perform all tests and inspections as specified herein. All references made to “testing firm” shall apply to the work of the Contractor.

B. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

C. It is the intent of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design Specifications.

D. The test and inspections shall determine suitability for energization.

E. Equipment to be tested and inspected shall be the equipment shown on the one-line diagram and schedules as required by part three of each individual Specification Section. In addition, all equipment that is part of an emergency distribution system shall be tested.

1.03 REFERENCES

A. All inspections and tests shall be in accordance with the latest version of the following codes and standards except as provided otherwise herein.

1. National Electrical Manufacturer's Association - NEMA
2. American Society for Testing and Materials - ASTM
3. Institute of Electrical and Electronic Engineers - IEEE
4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-2017
5. InterNational Electrical Testing Association - NETA Maintenance Testing Specifications-MTS-2015
6. American National Standards Institute - ANSI C2: National Electrical Safety Code
7. State and Local Codes and Ordinances
8. Insulated Cable Engineers Association - ICEA
9. Association of Edison Illuminating Companies - AEIC
10. Occupational Safety and Health Administration
11. National Fire Protection Association - NFPA

    a. ANSI/NFPA 70: National Electrical Code
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance
    c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
    d. ANSI/NFPA 101: Life Safety Code

1.04 QUALIFICATIONS

A. The testing firm shall be a corporately independent testing organization, which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The lead, on site, technical person and at least 50% of the onsite crew shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies in Electrical Power Distribution System Testing.

D. The testing firm shall only utilize technicians who are regularly employed by the firm on a full-time basis for testing services.

E. The Contractor shall submit proof of the above qualifications with bid proposal.

F. The terms used here within such as Test Agency, Test Contractor, Testing Laboratory, or Contractor Test Company, shall be construed to mean the testing organization.

1.05 PERFORMANCE REQUIREMENTS

A. The Electrical Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the power requirements.

B. The Electrical Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

C. The testing firm shall notify the Owner's Representative prior to commencement of any testing.

D. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported to the Engineer. The Electrical Contractor shall correct all defects.

E. The testing organization shall maintain a written record of all tests and shall assemble and certify a final test report.

F. Safety and Precautions

1. Safety practices shall include, but are not limited to, the following requirements:

    a. Occupational Safety and Health Act.
    b. Accident Prevention Manual for Industrial Operations, National Safety Council.
    c. Applicable state and local safety operating procedures.
    d. NETA Safety/Accident Prevention Program.
    e. Owner's safety practices.
    f. National Fire Protection Association - NFPA 70E.
    g. American National Standards for Personnel Protection.

2. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
3. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

1.06 TEST INSTRUMENT CALIBRATION

A. Test Instrument Calibration

1. The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instruments shall be calibrated in accordance with the following frequency schedule:

    a. Field instruments: Analog - 6 months maximum Digital - 12 months maximum
    b. Laboratory instruments: 12 months
    c. Leased specialty equipment: 12 months (Where accuracy is guaranteed by Lessor)

4. Dated calibration labels shall be visible on all test equipment.
5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
6. An up-to-date instrument calibration instruction and procedures shall be maintained for each test instrument.
7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

B. Field Test Instrument Standards

1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:

    a. Maintained in good visual and mechanical condition.
    b. Maintained in safe, operating condition.

C. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.
2. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multi-meters may be average of RMS sensing and may include or exclude the dc component. When the variable contains harmonics of dc offset and, in general, any deviation from a pure sine wave, average sensing, average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.
3. Field test metering used to check power system meter calibration must have any accuracy higher than that of the instrument being checked.
4. Accuracy of metering in test equipment shall be appropriate for the test being performed.
5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

1.07 TEST REPORTS

A. A test report shall be generated for each piece of major equipment or groups of equipment and shall include the following:

1. A list of visual and mechanical inspections required by Division 26 Specification Sections in a checklist or similar format.
2. Test reports, including test values where applicable, for all required electrical tests. Clearly indicate where test values fall outside of the limits of recommended values.
3. Summary and interpretation of test results detailing problems located and recommended corrective measures.

4. Record of infrared scan and photos showing potential problem locations.
5. Signed and dated by the testing firm field superintendent stating that all required tests have been completed.

B. Test reports shall be furnished to the Architect/Engineer within 14 days of the completion each test on an ongoing basis. Original copies of the reports shall be furnished directly to the Architect/Engineer by the testing company prior to formal submittal via the Contractors.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 THERMOGRAPHIC SURVEY

A. Visual and Mechanical Inspection

1. Remove all necessary covers prior to scanning.
2. Inspect for physical, electrical, and mechanical condition.

B. Equipment to be Scanned

1. All components of the distribution system down to and including branch circuit panelboards and motor control centers. Return 3 months after equipment has been energized and loaded to do a final scan of all equipment.

C. Provide report indicating the following:

1. Problem area (location of "hot spot").
2. Temperature rise between "hot spot" and normal or reference area.
3. Cause of heat rise.
4. Phase unbalance, if present.
5. Areas scanned.

D. Test Parameters

1. Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.

E. Test Results

1. Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:

    a. Temperature gradients of 37°F to 44.6°F indicate possible deficiency and warrant investigation.
    b. Temperature gradients of 44.6°f to 59°F indicate deficiency; repair as time permits.
    c. Temperature gradients of 61°F and above indicate major deficiency; repair immediately.

END OF SECTION 26 09 99

SECTION 26 22 00 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 750 kVA:

1. Distribution transformers.

B. Related Section includes the following:

1. Division 26 Section “Electrical General Requirements.”
2. Division 26 Section “Grounding and Bonding.”
3. Division 26 Section “Conductors and Cables.”
4. Division 26 Section “Raceways and Boxes.”
5. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 REFERENCES

A. ANSI/IEEE C57.12.9: Test Code for Dry-Type Distribution and Power Transformers

B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)

C. NEMA ST 1: Specialty Transformers

D. NEMA ST 20: Dry Type Transformers for General Applications

E. NEMA TP 1: Guide for Determining Energy Efficiency for Distribution Transformers

F. NEMA TP 2: Standard Test Method for Measuring the Energy Consumption of Distribution Transformers

G. NETA ATS: Acceptable Testing Specifications for Electrical Power Distribution Equipment and Systems

H. NFPA 70: National Electrical Code

I. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors

J. UL 486B: Wire Connectors for Use with Aluminum Conductors

K. UL 506: Specialty Transformers

L. UL 1561: Dry-Type General Purpose and Power Transformers

1.04 SUBMITTALS

A. Product Data Include rated nameplate data, capacities, weights, dimensions, utility or manufacturer's anchorage and base recommendations, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

1. Transformer Inrush: Provide time-current coordination curves demonstrating transformer inrush and ANSI damage curves with primary overcurrent device selections to clear inrush yet still protecting damage curve.

B. Shop Drawings: Wiring and connection diagrams.

C. Qualification Data: Testing agency.

D. Source quality-control test reports. Include loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

E. Output Settings Reports: Record of tap adjustments specified in Part 3.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C 57.12.91.

C. Comply with NFPA 70.

D. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting doe 2016 efficiency levels when tested according to NEMA TP2.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

B. Store, protect, and handle products to site under provisions of Division 26 section “Electrical General Requirements.”

C. Deliver transformers individually wrapped for protection and mounted on shipping skids.

D. Accept transformers on site. Inspect for damage.

E. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

F. Handle in accordance with manufacturer’s written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 “Hangers and Supports for Electrical Systems.”

B. Coordinate installation of wall-mounting and structure-hanging supports.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme.
2. Cutler-Hammer.
3. GE Electrical Distribution & Control.
4. Siemens Industries, Inc.
5. Square D/Groupe Schneider NA.
6. Sola/Hevi-Duty Electric.

2.02 MATERIALS

A. Cores: Grain-oriented, non-aging silicon steel.

B. Coils: Continuous windings without splices, except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum.

C. Vibration Isolation: Isolate core and coil from enclosure using vibration-absorbing mounts.

D. Grounding: Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

2.03 DISTRIBUTION TRANSFORMERS

A. Description: Factory-assembled and tested, air cooled, dry-type transformer rated for 60 Hz operation. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers with base KVA as indicated without the use of internal cooling fans.

C. Cores: One leg per phase.

D. Indoor Enclosure: Ventilated, NEMA 250, Type 2. Provide lifting eyes or brackets.

E. Indoor Transformer Enclosure Finish: Comply with NEMA 250 for “Indoor Corrosion Protection."

1. Finish Color: Gray.

F. Enclosure Finish for Indoor Units: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.

G. Insulation Class (15 kVA and larger): 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature TP-1 compliant.

H. Insulation Class (less than 15 kVA): 185 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

I. Basic Impulse Level: 10 kV.

J. Taps for Transformers Smaller Than 3 kVA: None.

K. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

L. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

M. Case Temperature: Do not exceed 35 degrees C rise above ambient at warmest point.

N. Mounting: Suitable for mounting as indicated.

O. Wall Brackets: Manufacturer's standard brackets.

P. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.04 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Provide the following factory tests on each unit provided in accordance with NEMA ST 20:

1. Voltage ratio.
2. Polarity and phase relation.
3. No load losses.
4. Impedance (501 kVA and larger).
5. Applied and induced potential.

C. Provide the factory tests on the actual transformers provided or on similar units identical to those provided in accordance with NEMA ST 20:

1. Impedance (less than 501 kVA).
2. Temperature rise.
3. Audible sound level.
4. Full load losses.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls and floors for suitable mounting conditions where transformers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install Products in accordance with manufacturer’s instructions.

B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

C. Install floor mounted transformers on and anchor to concrete bases according to manufacturer’s recommendations.

1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

D. Identification: Engraved metal or laminated-plastic nameplate mounted with corrosion resistant screws. Provide nameplate according to Division 26 Section “Electrical Identification” indicating the following:

1. Transformer designation (e.g., “T-1”).
2. Primary power characteristics (e.g., “480V, 3PH, 3W”).
3. Secondary power characteristics (e.g., “208Y/120V, 3PH, 4W”).
4. Power rating (e.g., “75 kVA”).
5. Power source (e.g., “Fed from DP-1).

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

C. Provide conduit according to Division 26 Section “Raceways and Boxes” for connections to transformer case. Make conduit connections to side panel of enclosure.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Check for damage and tighten connections prior to energizing transformer.

3.04 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing” for transformers 75KVA and above:

1. Visual and Mechanical Inspection

    a. Inspect for physical damage, cracked insulators, tightness of connections, defective wiring and general mechanical and electrical conditions.
    b. Verify proper core grounding.
    c. Verify proper equipment grounding.
    d. Compare equipment nameplate with single line diagram and report discrepancies.

2. Electrical Tests

    a. Perform insulation resistance tests, winding-to-winding and windings-to-ground, utilizing a meg-ohmmeter with test voltage output in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Test duration shall be for 10 minutes with resistance values tabulated at 30 seconds, 1 minute, and 10 minutes. Calculate Polarization index.
    b. Perform a turns ratio test between windings at every tap position. The final tap setting is to be set at the secondary system rated voltage at full load or as directed by the Architect/Engineer.
    c. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3. Test Values

    a. Perform insulation resistance tests in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Results to be temperature corrected in accordance with Table 10.14.
    b. The polarization index should be above 1.2 unless an extremely high value is obtained initially, such that when doubled will not yield a meaningful value.
    c. Turns ratio test results shall not deviate more than one half percent (0.5%) from either the adjacent coils or the calculated ratio.

3.05 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent. Submit recording and tap settings as test results.

B. Adjust buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report that records output voltages and tap settings.

END OF SECTION 26 22 00

SECTION 26 24 16 - PANELBOARDS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. AFCI: Arc-fault circuit interrupter.

E. RFI: Radio-frequency interference.

F. RMS: Root mean square.

G. SPDT: Single pole, double throw.

1.04 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Related Submittals:

1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.

C. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

    a. Enclosure types and details for types other than NEMA 250, Type 1.
    b. Bus configuration, current, and voltage ratings.
    c. Short-circuit current rating of panelboards and overcurrent protective devices.
    d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.
3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.07 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton Corporation; Cutler-Hammer Products.
b. GE by ABB.
c. Siemens Industries, Inc.
d. Square D.

2.02 MANUFACTURED UNITS

A. Enclosures: Mounting as noted on panel schedules. NEMA PB 1, Type 1.

1. Cabinet Front: Flush or surface cabinet as noted on the Drawings.

a. Eaton LTDD (Piano hinge trim)

b. GE – FGB (front hinge to box).
c. Square D – Continuous piano hinge trim.
d. Siemens – Figure 4 hinge to box w/piano hinge.

2. Finishes:

a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.

3. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

B. Phase and Ground Buses:

1. Material: Aluminum.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box as called out on panel schedules.

C. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Compression type.
3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
4. Double Lugs: Mechanical type mounted at location of main incoming lugs.

D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.03 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.04 DISTRIBUTION PANELBOARDS

A. Main bus bars, neutral and ground, shall be aluminum and sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

C. Main Overcurrent Protective Devices: Circuit breaker.

D. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
3. Fused switches.

2.05 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Main bus bars, neutral and ground, shall be sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.06 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.

    a. Circuit Breakers 250A and Larger: Magnetic trip element with front-mounted, field-adjustable trip setting with restricted access cover.

2. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings with restricted access cover:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. AFCI Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
5. Shunt Trip: 120-V trip coil energized from separate circuit.
6. Do not use tandem circuit breakers.
7. Provide lock on devices for circuit breakers when called out on panel schedules with “LOD” designation.
8. Provide type GFEP circuit breakers for all self- regulating heating (snow melting and heat trace) cables branch circuits and where noted on panel schedules with “GFEP” designation
9. Provide GFCI circuit breaker when called out on panel schedules with “GFCI” designation.
10. Provide Arc-Fault Circuit Interrupters where indicated on panel schedule with “AFCI” designation.
11. Provide shunt trip breakers when called out on panel schedules with “STB” designation.
12. Provide permanent padlockable handle for circuit breakers when called out on panel schedules with “PL” designation.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

D. Fuses are specified in Division 26 Section "Fuses."

E. Circuit Breaker Selection for Transformer Primary Protection:

1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Provide permanent provisions for padlocking all overcurrent devices in Distribution Panelboards. Provisions shall remain in place whether or not lock is installed.

C. Provide permanent provisions for padlocking overcurrent devices in Branch Circuit Panelboards that serve equipment not provided with a local, lockable disconnecting means. Provisions shall remain in place whether or not lock is installed

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 26 Section “Hangers and Supports for Electrical Systems.”

C. Mount top of trim 74 inches above finished floor, unless otherwise indicated.

D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Install overcurrent protective devices and controllers.

1. Set field-adjustable switches and circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads or created by retrofitting. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Coordinate final directory room names and numbers with Facility Engineer.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters. Perform electrical tests on all breakers and switches 200A and above or that constitute a component of an emergency distribution system. Main circuit breakers in branch circuit panelboards 225A and below are not required to be tested.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles
2. Receptacles with integral USB charger.
3. Ground-fault circuit interrupter receptacles
4. Controlled receptacles.
5. Device wall plates.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. AFCI: Arc-fault circuit interrupter.

D. PVC: Polyvinyl chloride.

E. RFI: Radio-frequency interference.

F. SPD: Surge protective devices.

G. UTP: Unshielded twisted pair.

H. USB: Universal serial bus.

1.04 REFERENCES

A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.

B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes

D. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.

E. NEMA WD 1: General Requirements for Wiring Devices.

F. NEMA WD 6: Wiring Device – Dimensional Requirements.

G. UL 20: General-Use Snap Switches.

H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

I. UL 486B: Wire Connectors for Use with Aluminum Conductors.

J. UL 498: Electrical Attachment Plugs and Receptacles.

K. UL 943: Ground Fault Circuit Interrupters.

L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.07 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 2 PRODUCTS

2.01 GENERAL WIRING DEVICE REQUIREMENTS

A. Comply with NFPA 70, NEMA WD 1, NEMA WD 6, and UL498.

B. Device Color:

1. Wiring Devices Connected to Normal Power System: selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. Wiring Devices Connected to Optional Standby Power System: Red.
4. Wall Switches: As selected by Architect, unless otherwise indicated.

2.02 STANDARD GRADE RECEPTACLES

A. Duplex Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wiring Device-Kellems: BR20
b. Eaton/Arrow Hart Wiring Devices: BR20
c. Leviton: BR 20

d. Legrand, Pass & Seymour: CRB5362

B. Tamper-Resistant Duplex Receptacle, NEMA 5-20R:

1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wiring Device-Kellems: BR20TR
b. Eaton/Arrow Hart Wiring Devices: TRBR20
c. Leviton: TBR20
d. Legrand, Pass & Seymour: TR5352

C. Weather-Resistant Duplex Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wire Device-Kellems: BR20WR
b. Eaton/Arrow Hart Wiring Devices: WRBR20
c. Leviton: WBR20
d. Legrand, Pass & Seymour: WR20TR

D. Weather- and Tamper-Resistant Duplex Receptacle, NEMA 5-20R:

1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wire Device-Kellems: BR20WRTR
b. Eaton/Arrow Hart Wiring Devices: TWRBR20
c. Leviton: TWR20
d. Legrand, Pass & Seymour: WR5352TR

2.03 USB RECEPTACLES

A. Tamper-Resistant Duplex NEMA 5-20R and USB Charging Receptacle:

1. Decorator style.
2. Comply with UL 1310.
3. USB Charging 3.0A (minimum), 5VDC dual ports.

a. Comply with battery charging specification USB BC1.2
b. Compatible with USB 1.1/2.0/3.0 devices, including Apple products.

4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hubbell Wiring Device: USB20X2-x
    b. Eaton/Arrow Hart Wiring Devices: TR7756-x
    c. Leviton: T5632
    d. Legrand, Pass & Seymour: TR5362USB Full Duplex and USB

B. USB Charging Receptacle:

1. Decorator style.
2. Comply with UL 1310.
3. USB Charging 4.0A (minimum), 5VDC four-ports.

    a. Comply with battery charging specification USB BC1.2
    b. Compatible with USB 1.1/2.0/3.0 devices, including Apple products.

4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hubbell Wiring Device: USB4
    b. Eaton/Arrow Hart Wiring Devices: 7750
    c. Leviton: USB4P

2.04 GFCI RECEPTACLES

A. General:

1. Comply with UL 943

B. Duplex GFCI Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide one of the following:

    a. Hubbell Wiring Device-Kellems: GFRST20
    b. Eaton/Arrow Hart Wiring Devices: SGF20
    c. Leviton: GFNT2
    d. Legrand, Pass & Seymour: 2097

C. Tamper-Resistant Duplex GFCI Receptacle, NEMA 5-20R:

1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide one of the following:

    a. Hubbell Wiring Device-Kellems: GFTRST20
    b. Eaton/Arrow Hart Wiring Devices: TRSGF20
    c. Leviton: GFTR2

d. Legrand, Pass & Seymour: 2097TR

D. Tamper- and Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:

1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide one of the following:

a. Hubbell Wiring Device-Kellems: GFTWRST20
b. Eaton/Arrow Hart Wiring Devices: TWRSGF20
c. Leviton: GFWT2
d. Legrand, Pass & Seymour: 2097TRWR

E. Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide one of the following:

a. Eaton/Arrow Hart Wiring Devices WRSGF20
b. Leviton: GFWR2
c. Legrand, Pass & Seymour: 2097TRWR

2.05 CONTROLLED RECEPTACLES

A. General:

1. Comply with NEC Article 406.3(E). Provide permanent markings of controlled symbol and the word “controlled”.

B. Half-Controlled Duplex Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wiring Device-Kellems: BR20C1
b. Eaton/Arrow Hart Wiring Devices: 5262CH
c. Bryant: CBRS20C1
d. Leviton: CR020-1P
e. Legrand, Pass & Seymour: 5362CHW

C. Dual-Controlled Duplex Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wiring Device-Kellems: BR20C2
b. Eaton/Arrow Hart Wiring Devices: 5362CD

c. Bryant: CBRS20C2
d. Leviton: CR020-2P
e. Legrand, Pass & Seymour: 5362CD

2.06 STRAIGHT BLADE AND TWIST-LOCK RECEPTACLES, OTHER THAN NEMA 5-20R

A. Provide commercial specification grade straight blade and twist-lock receptacles with standard NEMA configurations in accordance with the "Special Receptacles" schedule included on the drawings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Wiring Device-Kellems
2. Eaton/Arrow Hart Wiring Devices
3. Leviton
4. Legrand, Pass & Seymour

2.07 WALL SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Wiring Device-Kellems: 1220 Series
2. Eaton/Arrow Hart Wiring Devices: AH1220 Series
3. Leviton: 1220 Series
4. Legrand, Pass & Seymour: PS20AC Series

B. Device body: Plastic handle.

C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.

E. Provide single-pole, two-pole, three-way and four-way switches as indicated.

F. Provide pilot light where indicated. Switch shall be illuminated when the switch is on.

G. Provide key type where indicated. Furnish four keys to Owner.

H. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.

1. Switch: 20 A, 120/277-V ac.
2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.08 WALL PLATES

A. Manufacturers:

1. Provide wall plates and corresponding wiring devices from same manufacturer.

B. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces:

a. 0.035-inch- thick, satin-finished stainless steel
b. Steel with white baked enamel, suitable for field painting
c. Smooth, high-impact thermoplastic
d. 0.04-inch thick, brushed brass with factory polymer finish
e. 0.05-inch- thick anodized aluminum
f. 0.04-inchthick steel with chrome-plated finish

3. Material for Unfinished Spaces:

a. Galvanized steel
b. Smooth, high-impact thermoplastic.

4. Material for Wet Locations: Gasketed Non-Metallic with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.

a. Manufacturers:

1) Hubbell: MM420
2) Legrand, Pass & Seymour: WIUC10FRED
3) Eaton/Arrow Hart: WIU-1VX
4) Red Dot: CKPS
5) Intermatic: WP5000

5. Material for Damp Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Weatherproof.

a. Manufacturers:

1) Red Dot Model CCGV, ABB Installation Products
2) Eaton/Arrow Hart WLRD1
3) Legrand, Pass & Seymour
4) Intermatic: WP3110MXD

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.

C. Install devices and assemblies level, plumb, and square with building lines.

D. Arrangement of Devices:

1. Coordinate locations of outlet boxes provided under Division 26 Section "Raceways and Boxes" to obtain mounting heights indicated on Drawings.
2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.
3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
4. Install horizontally mounted receptacles with grounding pole on the left.
5. Install GFCI receptacles so that the "Push To Test" and "Reset" designations can be read correctly. If printed in both directions, install with ground pole on top.
6. Install switches with OFF position down.

E. Install cover plates on switch, receptacle, and blank outlets in finished areas.

F. Install weather-resistant type receptacles in all damp and wet locations, including pool environments.

G. Install weatherproof cover plates on receptacles in damp locations.

H. Install weatherproof While-In-Use cover plates on receptacles in wet locations.

I. Install tamper-resistant type receptacles in all locations as required by the NEC (406.12) and as indicated on plan.

J. Use oversized plates for outlets installed in masonry walls.

K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

L. Remove wall plates and protect devices and assemblies during painting.

M. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

N. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section “Electrical Identification” with black-filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.
2. Wall Switches: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section “Electrical Identification” with black filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.

B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Inspect each wiring device for defects.
2. Operate each wall switch with circuit energized and verify proper operation.
3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches, panelboards, and controllers.

1.03 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

a. Let-through current curves for fuses with current-limiting characteristics.
b. Time-current curves, coordination charts and tables, and related data.
c. Ambient temperature adjustment information.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with:

1. NEMA FU 1 – Low Voltage Cartridge Fuses.
2. NFPA 70 – National Electrical Code.
3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
4. UL 198E – Class R Fuses.
5. UL 512 – Fuseholders.

1.05 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than 3 of each type and size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

1. Feeders: Class RK1, time delay or RK5, time delay.
2. Motor Branch Circuits: Class RK5, time delay.
3. Other Branch Circuits: Class RK1, time delay.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

C. Install spare-fuse cabinet(s).

3.03 IDENTIFICATION

A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 26 Section “Fuses”.

1.02 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers.

4. Molded-case switches.
5. Enclosures.

B. Related Sections:

1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. HD: Heavy duty.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.04 REFERENCES

A. NECA 1: Practices for Good Workmanship in Electrical Contracting.

B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.

E. NEMA FU 1: Low Voltage Cartridge Fuses.

F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.

I. NFPA 70: National Electrical Code.

1.05 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current rating.
4. UL listing for series rating of installed devices.
5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Qualification Data: For testing agency.

D. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.08 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spares: For the following:

a. Potential Transformer Fuses: 2 of each size and type.
b. Control-Power Fuses: 2 of each size and type
c. Fuses for Fusible Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.

2. Spare Indicating Lights: Six of each type installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Industries, Inc.

4. Square D/Group Schneider.

B. Fusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, with clips or bolt pads to accommodate specified fuses, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Provide early break auxiliary contacts in motor disconnect switches for motors that are fed from variable frequency controllers.
2. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
3. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.03 TOGGLE DISCONNECT SWITCH

A. Manufacturers:

1. Double Pole:

a. Hubbell 1372.
b. Leviton 6808G-DAC.
c. Pass & Seymour 7812.
d. Bryant 30102.

2. Three Pole:

a. Hubbell 1379.
b. Leviton 7810GD.
c. Pass & Seymour 7813.
d. Bryant 30103.

B. Description: Heavy duty, 30A, 600 volt, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

2.04 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.

2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Industries, Inc.
4. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity as required.

C. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
2. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Enclosure: Provide handle capable of being locked in the open position with padlock.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
6. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

E. Molded-Case Switch Accessories:

1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.
4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay. Provide "dummy" trip unit where required for proper operation.
5. Key Interlock Kit: Externally mounted to prohibit operation; key shall be removable only when switch is in off position.
6. Circuit breaker selection for primary

F. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

2.05 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Indoor Dry Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.03 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Install switches with off position down.

D. Install NEMA KS 1 enclosed switch where indicated for motor loads ½ HP and larger and equipment loads greater than 30A.

E. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than ½ HP and equipment loads 30A. and less.

F. Install fuses in fusible disconnect switches.

G. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6’-0” whip.

H. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.

I. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.

J. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.

K. Support enclosures independent of connecting conduit or raceway system.

L. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification."

C. Provide adhesive label as specified in Division 26 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

3.05 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

C. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. Certify compliance with test parameters.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.6 for molded-case circuit breakers. Test all NEMA AB1, molded case circuit breakers with thermal magnetic trip or auxiliary, solid-state trip units 100A and larger. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection

        1) Circuit breaker shall be checked for proper mounting and compare nameplate data to Drawings and Specifications.
        2) Operate circuit breaker to ensure smooth operation.
        3) Inspect case for cracks or other defects.
        4) Check internals on unsealed units.

    b. Electrical Tests

        1) Perform a contact resistance test.
        2) Perform an insulation resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
        3) Perform long time delay time-current characteristic tests by passing three hundred percent (300%) rated current through each pole separately. Record trip time. Make external adjustments as required to meet time current curves.
        4) Determine short time pickup and delay by primary current injection.
        5) Determine ground fault pickup and time delay by primary current injection.
        6) Determine instantaneous pickup current by primary injection using run-up or pulse method.
        7) Perform adjustments for final settings in accordance with coordination study.
        8) For circuit breakers 800A and larger, verify all functions of trip unit by means of secondary injection in lieu of primary injection.

c. Test Values

1) Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.
2) Insulation resistance shall not be less than 100 megohms.
3) Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) All trip times shall fall within N.E.T.A. Acceptance Testing Specifications, Table 10.7 Circuit breakers exceeding specified trip time at three hundred percent (300%) of pickup shall be tagged defective.
5) Instantaneous pickup values shall be within values shown on N.E.T.A. Acceptance Testing Specifications, Table 10.8 or manufacturer's recommendations.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.06 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 28 16

SECTION 26 51 19 - LED INTERIOR LIGHTING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.

2. Lighting fixture supports.

B. Related Requirements:

1. Division 26 "Lighting Control Devices."

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lamp: LED and substrate as a replaceable assembly.

F. LED: Light-emitting diode.

G. Lumen: Measured output of lamp and luminaire, or both.

H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

7. Moldings.

D. Qualification Data: For testing laboratory providing photometric data for luminaires.

E. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency

G. Sample warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 5% attic stock of each type and rating installed. Furnish at least one of each type.
2. LED Drivers 5% attic stock of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: 1% attic stock of each type and rating installed. Furnish at least one of each type.

1.07 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with:

1. NFPA 70 - National Electrical Code.
2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
4. Code of Federal Regulations (47 CFR 37342).
5. Michigan Department of State Police, Fire Marshall Division Policy Number 11-06 “Plastic Materials as Interior Finishes” pertaining to the use of plastic lenses in lighting fixtures for health care facilities.
6. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.

F. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.09 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) or manufacturer's standard warranty length (whichever is longer) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 LUMINAIRES (LIGHTING FIXTURES)

A. Provide Luminaires as included in specification 26 5700 "Luminaire Product Data." This section contains product data sheets from the basis of design manufacturer with annotations.

B. Acceptable alternate manufacturers are indicated on the product data sheets. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.

C. The Luminaire schedule shown on the drawings is supplemental provided for convenience and reference only. The requirements of this section and 26 5700 shall govern.

2.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.

D. Unless otherwise specified in Luminaire product data, provide products with a CCT of 4000 K.

E. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 50,000 hours.

F. Driver

1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaries.
2. Nominal Input Voltage: All drivers shall be rated for use on either 120V or 277V systems.

2.03 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

D. Provide edge lit signs with a mirror plaque background.

2.04 EMERGENCY AUTOMATIC LOAD CONTROL RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bodine BLCD Series.
2. Nine-24, Inc.: ELCR Series.
3. LVS, EPC Series
4. IOTA, ETS-20 Series
5. Functional Devices, Inc., ESR Series
6. ETC, ALCR Series
7. Wattstopper, ELCU series

B. Description:

1. The Automatic Load Control Relay (ALCR) shall provide required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area of the building.
2. The ALCR shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device.
3. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
4. Self-contained with integral ½" nipple mount with snap in locking feature for mounting into a standard junction box knock out.
5. Normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.

6. Universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
7. Integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.
8. Dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.
9. Separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).
10. Normal power input leads shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
11. Automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
12. Utilize zero crossing circuitry to protect relay contacts from inrush current.
13. Plenum rated housing equipped with compression flying leads.
14. The unit shall be UL listed to the UL924 standard and labeled for connection to both normal and emergency lighting power sources.

C. Provide device with proper rating for total load and load type being transferred

D. Provide for devices suitable for line voltage and low voltage dimming control where required such that device bypasses dimming control signal to luminaire to provide full output upon loss of normal power.

E. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings for dimming characteristics.

2.05 BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. LVS EPC-D-F-ATS Series
2. Bodine.

B. Description: Localized load transfer switch to allow emergency fixture to be powered and controlled by the normal lighting circuit, sense presence of normal power ahead of control circuit and switch luminaire (both line and neutral) over to emergency source upon loss of normal source.

C. Universal dimming capability to allow the lighting to be controlled and dimmed by the normal lighting circuit during normal times. In the event of a loss of the normal branch circuit, and

transfer the designated emergency fixtures form normal dimming control to the emergency power source and bring them to full brightness, regardless of the current state of the dimming system.

D. Device shall be mounted remotely for each control circuit as application requires.

E. Listed and labeled by an NRTL to the UL1008 for emergency operation and listed for field installation.

F. Integral test switch and indicating lamps to indicate status.

G. Provide device with proper rating for total load and load type being transferred

H. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings.

2.06 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Factory-Applied Labels: Comply with UL 1598 Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.07 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.08 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: Unless otherwise specified in Luminaire product data, provide products with a minimum ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. Do not use permanent luminaires for temporary lighting.

3.03 INSTALLATION

A. Install in accordance with manufacturer’s instructions and N.E.C.A./I.E.S.N.A. 500-2006 and 502-2006.

B. Locate ceiling luminaires as indicated on reflected ceiling plan.

C. Support luminaires independent of ceiling framing. Support recessed grid luminaries from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Install recessed luminaires to permit removal from below.

E. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

F. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

G. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.

H. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

I. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

J. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

K. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

L. Comply with requirements in Section 26 05 19 "Conductors and Cables" for wiring connections.

M. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.

N. Locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

C. Bond products and metal accessories to branch circuit equipment grounding conductor.

D. Connect luminaires to branch circuit outlet boxes provided under Division 26 Section "Raceways and Boxes" using 1/2" flexible conduit.

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.06 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

D. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps, drivers, or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

B. Adjust exit sign directional arrows as indicated on Drawings.

C. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner's representative and Architect/Engineer.

3.08 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosures and lenses.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

END OF SECTION 26 51 19

SECTION 28 31 00 - FIRE ALARM

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements.”

1.02 SUMMARY

A. This Section includes and installation of new devices onto an existing fire alarm system.

B. Related Sections include the following:

1. Division 8 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.

1.03 DEFINITIONS

A. FACP: Fire alarm control panel.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.

D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.04 SYSTEM DESCRIPTION

A. Noncoded, addressable system; multiplexed signal transmission dedicated to fire alarm service only.

B. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.

C. Fire alarm system shall consist of the following:

1. System smoke detection above all control panels and notification appliance power supply panels.
2. System smoke detection as required at air handling units, smoke rated transfer openings, and smoke damper locations.
3. All flow and tamper switches to monitor fire sprinkler and standpipe systems and report appropriate alarm and supervisory signals.
4. Manual fire alarm boxes at each building exit (prior to entering exit stairwells at each floor).
5. Audible and visual notification appliances in all public and common areas of the building.

1.05 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72.

B. Comply with NFPA 70.

C. Comply with NFPA 720.

D. A complete functional system meeting the requirements of this specification, including alarm initiating devices and notification appliances at locations and ratings to meet the requirements of the Authorities Having Jurisdiction and all applicable codes shall be provided.

E. Coordinate and avoid conflicts with casework, markerboards, feature walls, and other areas where fire alarm devices would interfere with furnishings, finishes, etc.

F. Fire alarm system vendor shall provide sound pressure level calculations demonstrating compliance with NFPA 72 and establish quantities and tap settings of audible devices.

G. No additional charges for work or equipment required for a code compliant system approved by the Authority Having Jurisdiction will be allowed.

H. Obtain and refer to mechanical drawings for smoke damper locations, smoke rated transfer openings, and air handling equipment CFM's. Provide smoke detection as required by applicable codes.

I. Premises protection includes S-1 Type building use group.

1. Refer to drawings for complete code analysis including construction type, use groups, special occupancy types, rated walls, smoke barriers and partitions, etc.

J. System functional performance shall be as indicated on the fire alarm matrix on the drawings.

1.06 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire alarm system design.
b. Fire alarm certified by NICET, minimum Level III.

2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
3. Device Address List: Include address descriptions that will appear on the FACP display.

4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
6. Batteries: Provide battery sizing calculations. Battery size shall be a minimum of 125% of the calculated requirement.
7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
8. Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to scale and coordinating the installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
9. Voice/Alarm Signaling Service: Equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
10. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show device layout, size and route of cable and conduits.

C. Qualification Data: For Installer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.

F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

G. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and Authorities Having Jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.

    a. Hard copies on paper to Owner, Architect, and Authorities Having Jurisdiction.
    b. Electronic media may be provided to Architect.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Work of this Section be performed by a UL-listed company.

C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level III.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.08 PROJECT CONDITIONS

A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Architect, Construction Manager and Owner no fewer than seven days in advance of proposed interruption of fire alarm service.
2. Do not proceed with interruption of fire alarm service without Architect, Construction Manager and Owner written permission.

1.09 SEQUENCING AND SCHEDULING

A. Existing Fire Alarm Equipment: Maintain fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of the new fire alarm system, remove existing disconnected fire alarm equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FACP and Equipment:

a. Edwards Systems Technology Inc.
b. NOTIFIER; a Honeywell Company.
c. Siemens Building Technologies, Inc.; a Cerberus Division.

d. SimplexGrinnell LP; a Tyco International Company.
e. Gamewell-FCI; a Honeywell Company.
f. National Time & Signal.
g. Xtralis.

2.02 EXISTING FIRE ALARM SYSTEM

A. Compatibility with Existing Equipment: Fire alarm system and components shall operate as an extension of an existing system.

2.03 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP. Double action pull stations shall meet ADA guidelines.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.04 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Multipurpose type, containing the following:

    a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
    b. Piezoelectric sounder rated at 88 dBA at 10 feet according to UL 464.
    c. Heat sensor, combination rate-of-rise and fixed temperature.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

    a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 155 deg F.
    c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

C. Ionization Smoke Detector:

1. Sensor: Responsive to both visible and invisible products of combustion. Self-compensating for changes in environmental conditions.
2. Detector Sensitivity: Between 0.5 and 1.7 percent/foot smoke obscuration when tested according to UL 268A.

D. Beam-Type Smoke Detector:

1. Xtralsis Open-Area Smoke Imaging Detection (OSID).
2. UL 268 listed, operating at 24-V dc, nominal.
3. Smoke Detector: Dual wavelength particle detection with optical imaging.
4. Transmitters and Receivers: Each detector shall consist of the maximum number of transmitters per receiver, as specified by the manufacturer conditions.
5. Adjustable Sensitivity: At least three sensitivity levels, settable at the receiver, measured as percent of obscuration.
6. Misalignment Angle: Minimum tolerance of 1°.
7. Two selectable alarm delay settings, allowing each to be associated with a corresponding sensitivity.
8. Trouble signal delay, fixed at 20 seconds.
9. Separate Color-Coded LEDs: Indicate normal, alarm, and trouble status with remote indicator panels.

E. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.

1. UL 268 listed, operating at 24-V dc, nominal.
2. Pipe Network: Electrical metallic tubing connects control unit with designated sampling holes.
3. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of three preset values.

4. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05-inch wg at all sampling ports.
5. Control Unit: Single or multizone unit as indicated. Provides same system power supply, supervision, and alarm features as specified for the central FACP plus separate trouble indication for airflow and detector problems.
6. Signals to the Central FACP: Any type of local system trouble is reported to the central FACP as a composite "trouble" signal. Alarms on each system zone are individually reported to the central FACP as separately identified zones.

F. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

    a. Sensor: LED or infrared light source with matching silicon-cell receiver.
    b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

2. Ionization Smoke Detectors:

    a. Sensor: Responsive to both visible and invisible products of combustion. Self-compensating for changes in environmental conditions.
    b. Detector Sensitivity: Between 0.5 and 1.7 percent/foot smoke obscuration when tested according to UL 268A.

3. UL 268A listed, operating at 24-V dc, nominal.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
5. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.

    a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.

6. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
7. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where required.
8. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
9. Each sensor shall have multiple levels of detection sensitivity.
10. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
11. Relay Fan Shutdown: Provide two (2) sets of contacts rated to interrupt fan motor-control circuit.

2.05 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

D. Continuous Linear Heat-Detector System: Consists of detector cable and control unit.

1. Detector Cable: Rated detection temperature 155 deg F. Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.
2. Control Unit: Two-zone or multizone unit as indicated. Provides same system power supply, supervision, and alarm features as specified for the central FACP.
3. Signals to the Central FACP: Any type of local system trouble is reported to the central FACP as a composite "trouble" signal. Alarms on each detection zone are individually reported to the central FACP as separately identified zones.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.06 FLAME DETECTORS

A. Ultraviolet type with solid-state amplifier-switching circuit set for 10-second delay, unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting or Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.07 SYSTEM CARBON MONOXIDE DETECTORS

A. General Description:

1. UL 2075 listed, operating at 24-V dc, nominal.
2. Provide means for addressable connection to fire-alarm system.
3. Detector must communicate detector status (normal, alarm, or trouble) to the FACP.
4. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Detector must provide alarm contacts and trouble contacts.
6. Mounting: Adapter plate for outlet box mounting.
7. Testable by introducing test carbon monoxide into sensing cell.
8. Locate, mount, and wire in accordance with manufacturer's written instructions.
9. Test button simulates alarm condition.

2.08 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
2. Finishes:

    a. Wall mounted appliances: Provide red finish with white lettering.
    b. Ceiling Mounted Appliances: Provide white finish.

B. Bells: Electric-vibrating, 24-V dc, under-dome type; with provision for housing the operating mechanism behind the bell. Bells shall produce a sound-pressure level of 94 dBA, measured 10 feet from the bell. 10-inch size, unless otherwise indicated. Provide weatherproof bells where shown on building exterior and in other wet and damp locations.

C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

F. Voice/Tone Speakers:

1. UL 1480 listed.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

G. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output: 15, 30, 60, 75, 110, 135, 185 candela as required to meet NFPA 72 requirements.
2. Strobe Leads: Factory connected to screw terminals.

2.09 REMOTE STATUS AND ALARM INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.10 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.

1. Mounting: Surface cabinet, NEMA 250, Class 1.

B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.11 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

2.12 ADDRESSABLE CONTROL MODULE

A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:

1. Communication interaction with the analog signaling circuit having the capability of initiating a control function to an auxiliary device based on a specified event.
2. Provide NO/NC contact pairs rated at 2 amps 120 VAC or 24 VDC.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled according to UL 632.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote

central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.14 GUARDS FOR PHYSICAL PROTECTION

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of the device.
2. Finish: Paint of color to match the protected device.

2.15 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Fire alarm wire and cable shall be as specified by the system manufacturer including conductor gage, conductor quantity, conductor twists and shielding required to meet NFPA class and style performance specified.

C. Signaling Line Circuits and other power limited fire alarm circuits (PLFA):

1. PLFA circuits installed in conduit or raceway: U.L. Listed type FPL
2. PLFA circuit cable installed exposed in accessible ceiling spaces, risers and elsewhere: U.L. Listed type FPLP.
3. PLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Circuit integrity cable, NFPA 70 Article 760, Classification CI, UL listed as Type FPL, FPLR or FPLP as required, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.

D. Non-Power-Limited Fire Alarm Circuits (NPLFA):

1. NPLFA circuits installed in conduit: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

a. Low-Voltage Circuits: No. 16 AWG, minimum.
b. Line-Voltage Circuits: No. 12 AWG, minimum.

2. NPLFA circuit cable installed exposed in ceiling spaces, risers and elsewhere: Multi-conductor cable, U.L Listed type NPLFP.
3. NPLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Multi-conductor cable, U.L Listed type NPLFP-CI.
4. NPLFA circuit cable installed exposed in ceiling spaces, shafts and elsewhere: Multi-conductor Armored Cable, NFPA 70 Type MC, copper conductors, copper drain wire, aluminum or steel armor with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.

1. Connect new equipment to the existing control panel in the existing part of the building.
2. Connect new equipment to the existing monitoring equipment at the Supervising Station.
3. Expand, modify, and supplement the existing control and monitoring equipment as necessary to extend the existing control and monitoring functions to the new points.
4. New components shall be capable of merging with the existing configuration without degrading the performance of either system.

B. Smoke or Heat Detector Spacing:

1. Smooth ceiling spacing shall not exceed 30 feet or the listed spacing of the detectors, whichever is less.
2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

C. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

D. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct.

E. Remote Status and Alarm Indicators: Install near each smoke detector, each duct detector and each sprinkler water-flow switch and valve-tamper switch that is above 10’-0” aff, concealed, or otherwise not readily visible from normal viewing position. Coordinate exact locations with local fire department and submit to architect for approval.

F. Audible Alarm Notification Appliances: Install wall mounted appliances not less than 6 inches below the ceiling.

G. Visible Alarm Notification Appliances: Install wall mounted appliances at 96” AFF or 6 inches below the ceiling, whichever is less.

H. Coordinate ceiling mounted appliances with reflected ceiling plans. Do not install visual appliances where pendant mounted or suspended lighting fixtures will obstruct intended viewing angles.

I. Install wall mounted and ceiling mounted notification appliances flush on recessed j-box or back box for all new work and on existing gyp-board partition walls.

J. Install notification appliances on existing CMU walls on surface back-boxes matching the dimensions and finish of the notification appliance.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. FACP: Surface mounted with tops of cabinets not more than 72 inches above the finished floor.

1. Install smoke detector above panel. Install on ceiling for ceilings under 10 ft. For ceilings above 10’, wall mount a smoke detector listed for releasing service 10’ AFF or 1’ below finished ceiling (whichever is lower).

M. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

N. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that will resist 100-mph wind load with a 1.3 gust factor without damage.

O. Provide all 120V branch circuits for all control panels, sub panels, and ancillary equipment required for the system.

3.02 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.
2. TIA/EIA 568-A.

B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes."

1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Fire alarm circuits shall consist of multi-conductor cables installed in accessible ceiling spaces.

2. Where ceilings consist of exposed construction, fire alarm multi-conductor cable shall be installed on top of joists, beams etc. and shall be concealed from view. Where the structural elements do not allow for the cable to be installed in a concealed fashion, then install the cable in conduit.
3. Install fire alarm cable in conduit in mechanical rooms, loading docks and similar service spaces.
4. Drops to surface mounted devices shall be installed in conduit or surface raceway. No exposed cable shall be visible below the ceiling. Where the ceiling is exposed, route the conduit or raceway up to the structural member that will conceal the cable.
5. Drops to devices recessed in partition walls shall be installed in conduit.
6. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
7. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits, if the system manufacturer permits it.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section “Electrical Identification."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.04 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

D. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.

    a. Include the existing system in tests and inspections.

3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
4. Testing: Follow procedure and record results complying with requirements in NFPA 72.

    a. Detectors that are outside their marked sensitivity range shall be replaced.

5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.06 PROGRAMMING

A. Coordinate final address descriptions for alarm, supervisory and trouble indication that appear on FACP and Annunciator displays with the Owners representative. This shall include all room names, room numbers, building areas for fire protection zones, exit door descriptions and similar items. This coordination shall take place and be implemented in the programming prior to Demonstration and Owner Training.

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

C. Semiannual Test and Inspection: Six months after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

D. Annual Test and Inspection: One year after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections.

3.08 WARRANTY

A. All newly installed equipment shall be warranted by the contractor for a period of one year following acceptance. The warranty shall include parts, labor, prompt field service, pickup and delivery.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 28 31 00

SECTION 312000
EARTH MOVING WITHIN BUILDING FOOTPRINT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subsurface drainage backfill for walls and trenches.
5. Excavating and backfilling trenches for utilities and pits for buried utility structures.
6. Excavating well hole to accommodate elevator-cylinder assembly.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
2. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Lining Course: Aggregate layer placed between the bedding course and subbase course or final backfill material.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill. Borrow material shall be GW.

E. Select Structural Fill: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.

2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase course, select structural fill, bedding course, or topsoil materials.

L. Drainage Course: Aggregate used for collecting drainage that connects to subsurface drainage utility.

M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.

2. Controlled low-strength material, including design mixture.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.

2. Laboratory compaction curve according to ASTM D 1557.

1.6 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

B. Preexcavation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Engineer.

C. Utility Locator Service: Notify "Dig Safe System" for area where Project is located before beginning earth moving operations.

D. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.

3. Foot traffic.

4. Erection of sheds or structures.

5. Impoundment of water.

6. Excavation or other digging unless otherwise indicated.

7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

E. Do not direct vehicle or equipment exhaust towards protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Select Structural Fill: Michigan Department of Transportation material 21A;

E. Drainage Course: Narrowly graded mixture of washed crushed stone; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

F. Sand: ASTM C 33; fine aggregate.

G. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.

2. Grab Tensile Strength: 157 lbf ; ASTM D 4632.

3. Sewn Seam Strength: 142 lbf ; ASTM D 4632.

4. Tear Strength: 56 lbf ; ASTM D 4533.

5. Puncture Strength: 56 lbf; ASTM D 4833.

6. Apparent Opening Size: No. 40, No. 60, No. 70 sieve, maximum; ASTM D 4751.

7. Permittivity: 0.2 per second, minimum; ASTM D 4491.

8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.

2. Grab Tensile Strength: 247 lbf ; ASTM D 4632.

3. Sewn Seam Strength: 222 lbf ; ASTM D 4632.

4. Tear Strength: 90 lbf ; ASTM D 4533.

5. Puncture Strength: 90 lbf ; ASTM D 4833.

6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.

7. Permittivity: 0.02 per second, minimum; ASTM D 4491.

8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150, Type II.

2. Fly Ash: ASTM C 618, Class C or F.

3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch nominal maximum aggregate size.

4. Foaming Agent: ASTM C 869.

5. Water: ASTM C 94/C 94M.

6. Air-Entraining Admixture: ASTM C 260.

B. Produce low-density, controlled low-strength material with the following physical properties:

1. As-Cast Unit Weight: 30 to 36 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.

2. Compressive Strength: 80 psi, when tested according to ASTM C 495.

2.4 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.

2. Yellow: Gas, oil, steam, and dangerous materials.

3. Orange: Telephone and other communications.

4. Blue: Water systems.

5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

1. 24 inches outside of concrete forms other than at footings.

2. 6 inches outside of minimum required dimensions of concrete cast against grade.

3. 6 inches beneath bottom of concrete slabs-on-grade.

4. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe.

B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Engineer. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

b. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

C. Measurements in subparagraphs below are examples only; revise to suit Project conditions and office standards and coordinate with rock measurement for unit prices, if any.

1. 24 inches outside of concrete forms other than at footings.

2. 12 inches outside of concrete forms at footings.

3. 6 inches outside of minimum required dimensions of concrete cast against grade.

4. 6 inches beneath bottom of concrete slabs-on-grade.

5. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Underground Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. N/A

3.7 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction**,** repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for Record Documents.

3. Testing and inspecting underground utilities.

4. Removing concrete formwork.

5. Removing trash and debris.

6. Removing temporary shoring and bracing, and sheeting.

7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Place and compact initial backfill of subbase and lining material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under building slabs, use engineered fill.

2. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Slabs: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Contractor will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.

2. Determine that fill material and maximum lift thickness comply with requirements.

3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Contractor will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Engineer.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SUPPLEMENTAL
SPECIFICATION FOR

MICHIGAN DEPARTMENT OF TRANSPORTATION SPECIFICATION SECTIONS:

205. Roadway Earthwork
301. Subbase
302. Aggregate Base Course
402. Storm Sewers
403. Drainage Structures
404. Underdrains
501. Plant-Produced Hot Mix Asphalt
602. Concrete Pavement Construction
901. Cement and Lime
902. Aggregates
903. Admixtures and Curing Materials for Concrete
904. Asphaltic Materials
905. Steel Reinforcement
909. Drainage Structures
910. Geosynthetics
911. Water
913. Masonry Units
914. Joint and Waterproof Materials
917. Turf and Landscaping Materials
1004. Portland Cement Concrete Mixtures
1005. Mortar and Grout Mixtures

This supplemental specification updates and revises the above noted specification. The below changes, revision and additions shall be included in the noted Michigan Department of Transportation Specification to follow.

1. **Delete all references to the "Department" and replace with "Engineer".**

2. **Revise applicable subsections, of the Standard Specifications for Construction, and replace with the following:**

    a. **Measurement and Payment.** All costs associated with this work are included in the price of the work for the relevant contract items. The Owner will not pay separately for work noted herein.

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Section 205. Roadway Earthwork

205.01. Description

This work consists of the following:

A. Constructing earth grades by excavating soil or rock and placing embankments or fills;

B. Salvaging and stockpiling selected materials;

C. Providing, placing, and compacting embankment materials;

D. Trimming the earth grade;

E. Disposing of surplus or unsuitable material; and

F. Maintaining the work in a finished condition until accepted by the Engineer.

Earth excavation consists of the work to excavate materials not otherwise addressed in the contract as separate work items. Rock excavation and subgrade undercutting are separate work items.

Investigate local conditions before bidding in accordance with subsection 102.04. Boring logs shown on the plans are for information only. Refer to MDOT's *Geotechnical Manual* for detailed data on soils.

G. **Definitions**

CIP. When used with an embankment item, CIP denotes compacted-in-place.

Frost heave textured material. Material with more than 50% silt particles by weight and a plasticity index of less than 10.

Loose measure (LM). Refer to section 109.01.B.2.

Silt. Material with a particle size from 0.002 mm to 0.075 mm.

Sound earth. Natural homogeneous material composed of soil or aggregate that can be compacted to the required density, contains no visible organic material, and has a maximum unit weight of at least 95 pounds per cubic foot.

205.02. Materials

Provide materials in accordance with the following sections:

Granular Material Class II, III 902
Open-Graded Aggregate 902
Geosynthetics 910

Do not use foundry sand from metal casting for roadway earthwork.

Refer to MDOT's *Density Testing and Inspection Manual* for maximum unit weight and in-place density test methods.

205.03. Construction

Before beginning earth-disturbing activities, install soil erosion and sedimentation control measures in accordance with section 208.

The Department considers buried rubbish and trash not identified in the contract a differing site condition in accordance with subsection 103.02.C. All buried rubbish and trash that are found must be disposed of properly.

A. **Preparing Roadway Foundation.** Remove material from the roadway foundation and salvage or dispose of. Compact the roadway foundation to the depth and density required.

Perform removal, salvage, and disposal operations in accordance with the following:

1. **Removing and Salvaging Topsoil.** Before removing topsoil, reduce vegetation to a height of 6 inches. Remove and dispose of cut vegetation, brush, rocks, and other unsuitable material.

Remove topsoil to the required depth from designated areas before excavating or placing embankment. Use equipment and methods that avoid lifting subsoil. Suspend topsoil removal if the Engineer determines that soil or weather conditions are unsuitable.

Submit a request to the Engineer in accordance with subsection 104.12 to temporarily stockpile topsoil inside the right-of-way.

Prior to temporarily stockpiling topsoil outside the right-of-way, obtain written permission from the owner of the property that has been designated for material placement and obtain required permits in accordance with subsection 208.03.A. Provide documentation to the Engineer before stockpiling topsoil. Do not stockpile temporarily or permanently in wetlands or floodplains.

Remove topsoil as follows:

a. In peat and muck areas, do not remove topsoil;

b. In borrow and clear vision areas, remove topsoil to the depth and width required;

c. At inlet, outlet, and berm ditch areas, remove topsoil within the construction limits; and

d. At roadway cut and embankment areas, remove topsoil within the limits of earth disturbance.

2. **Salvaging Materials.** Remove existing gravel, crushed stone, or selected excavated materials. The Contractor may salvage these materials. The Engineer may approve the use of salvaged materials to construct earth shoulders, approaches, or temporary roadway surfacing or to use in other work the Engineer determines appropriate. Do not salvage foreign or undesirable material. Temporarily stockpile salvaged material outside the limits of Contractor's earth disturbance and within the right-of-way limits, as approved by the Engineer.

   Surplus salvaged material is the property of the Contractor. Dispose of surplus salvaged materials in accordance with subsection 205.03.P before project completion.

3. **Disposing of Stones, Broken Rock, and Boulders.** For materials that cannot be incorporated in the work, dispose of the materials in accordance with subsection 205.03.P.

B. **Rock Excavation.** Excavate boulders with a volume of at least ½ cubic yard. Excavate rock or cemented soils that do not soften when wet or that cannot be removed without continuous drilling, blasting, or continuous use of a ripper or other special equipment.

   Expose the surface of the rock to allow the Engineer to measure before starting rock excavation. Remove rock encountered in the excavation to the required cross section and in accordance with all of the following:

   1. Excavate so no rock extends more than 6 inches above the lines of the required cross section;

   2. Excavate backslopes to the neat line slopes shown on the plans with no rock extending more than 12 inches from the true slope;

   3. Excavate the rock surface to provide drainage. Do not leave undrained pockets in the rock surface; and

   4. Remove rock or boulders loosened in the excavation and overhanging ledges on or outside the required cross section.

C. **Peat Excavation.** Remove peat, muck, marl, and very soft underlying clay. Coordinate removal with swamp backfill operations.

D. **Swamp Backfill.** Construct embankments across peat marshes as shown on the plans. Widen the embankment at culvert locations to provide a stable foundation for the length of the culvert, including headwalls and end sections. Provide granular material Class III for swamp backfill.

   If total excavation of peat results in a reasonably dry trench as determined by the Engineer, the Engineer may allow backfilling as a separate operation. Backfill the reasonably dry trench immediately after completing

the excavation in accordance with the controlled density method in subsection 205.03.H.4.a. Perform excavation and backfill as separate operations in shallow peat areas only with the Engineer's prior approval.

Coordinate the rate of advancement of the embankment and surcharge in deep swamps with the rate of excavation of the upheaved peat. If a trench of the required depth is not maintained full width ahead of the surcharge, use additional peat-excavating equipment or stop construction of embankment and surcharge until the two operations are in balance.

Dispose of peat as shown on the plans or in accordance with subsection 205.03.P.

The Department will bore swamp backfill to determine whether unsuitable material has been completely excavated or displaced. If the borings show the presence of unsuitable material under the swamp backfill, the Department will determine the corrective action. The Department will complete borings and notify the Contractor of corrective actions within 60 days after completion of the swamp backfill.

Corrective action may consist of excavating, placing a surcharge, excavating relief trenches, or a combination of these actions.

If a surcharge is placed over the swamp backfill, the Engineer will determine the width and elevation. Leave the surcharge in place until the Engineer determines that the swamp backfill is stable or the required settlement has taken place. The Engineer may require that the surcharge remain in place for up to 90 days.

Material from the surcharge is the property of the Contractor.

Obtain the Engineer's approval for swamp backfill and complete peat excavation and spreading before placing the pavement structure.

E. **Subgrade Undercutting.** Undercut the subgrade and backfill to replace material susceptible to frost heaving or differential frost action and to remedy unstable soil conditions.

Topsoil removal and peat excavation are not included in subgrade undercutting. Subgrade undercutting includes excavation below subgrade in cut sections, excavation at the transition from cut-to-fill sections, and excavation, other than peat excavation, as required below the topsoil in fill sections.

Excavated material from subgrade undercutting is the property of the Contractor.

1. **Limits of Subgrade Undercutting.** Excavate the subgrade to the approximate grade. The Engineer will promptly inspect the grade to

decide whether undercutting is necessary and to determine the limits of undercutting.

In shallow fill areas, the Engineer will inspect the fill area and determine the limits of the subgrade undercutting before the Contractor begins embankment placement.

Remove deposits of frost heave textured material within the subgrade surface limit. For areas north of the north boundary of Township 12 North, remove the frost heave textured material to a depth of 4 feet to 5 feet below the plan grade. For areas south of the north boundary of Township 12 North, remove the frost heave textured material to a depth of 3½ feet to 4 feet below the plan grade.

2. **Backfill of Subgrade Undercut.** Backfill subgrade undercutting Type I with selected clay or other Engineer-approved material.

   Backfill subgrade undercutting Type II with granular material Class II.

   Backfill subgrade undercutting Type III with the material excavated from subgrade undercut areas after mixing the excavated material to break up the undesirable strata of soils or with other Engineer-approved backfill material.

   Backfill subgrade undercutting Type IV with 21AA dense-graded aggregate or 4G open-graded aggregate. Encapsulate 4G aggregate with geotextile separator.

   Compact subgrade undercutting backfill to at least 95% of its maximum unit weight.

F. **Subgrade Manipulation.** Scarify, mix, and blend the roadbed subgrade to a depth of 12 inches below the top of subgrade. Compact to at least 95% of its maximum unit weight.

G. **Earth Excavation.** Excavated material is the property of the Contractor.

Compact the subgrade to at least 95% of its maximum unit weight and to a depth of at least 10 inches. If the subgrade cannot be compacted to 95% of its maximum unit weight using conventional construction methods, the Engineer may authorize the use of other methods to attain compaction.

In cut sections where the existing material appears to meet the requirements of subsection 301.02, excavate the grade to top of subbase rather than to the bottom of subbase. The Engineer will then determine whether the existing material meets subbase requirements. Shape material meeting subbase requirements to the top of subbase grade and compact to at least 95% of its maximum unit weight and to a depth of at

least 12 inches. The Engineer will adjust earthwork quantities accordingly. Excavate material not meeting subbase requirements to the bottom of subbase. The Department will not consider claims for damage caused by the Contractor's halting of grading operations so the Engineer can make subbase determinations.

Maintain the roadbed and ditches and provide drainage at all times. Install and remove temporary drainage facilities at no additional cost to the Department.

Perform grading to avoid removing or loosening material outside the required slopes. Replace and compact material removed or loosened outside the slopes to the required density and cross section.

Dispose of surplus or waste material resulting from ditch construction in accordance with subsection 205.03.P. Remove roots, stumps, or other materials that are unacceptable to the Engineer in the slopes and bottom of the ditch and backfill the holes with suitable material. Maintain ditches until the Engineer's final acceptance.

H. **Roadway Embankment**

1. **Stepping Side Slope.** Step embankments constructed on existing side slopes of 1:6 or steeper before placing embankment. Form steps with a horizontal dimension of at least 3 feet according to the *MDOT Standard Plan R-105* series.

2. **Borrow.** Borrow is defined in subsection 105.03. Excavate, transport, and place borrow material in accordance with subsection 105.03 and the following:

   After removal of borrow, leave borrow areas free formed without rigid geometric shapes. Make side slopes as flat as practical but ensure that slopes are no steeper than 1:4. Round the tops and bottoms of slopes with vertical curves to blend into adjacent terrain. Grade overburden left in the borrow area, except topsoil, to eliminate unsightly mounds, as determined by the Engineer.

   Where practical, shape borrow areas to drain, leaving usable land after completion. In granular soil, leave the area at least 12 inches above the high ground water level. In cohesive soil, leave the area at least 12 inches above the high-water elevation of the drainage outlet.

   If the borrow area cannot be drained, create a pond or a wetland. Create ponds by excavating to a depth of at least 8 feet below normal ground water level in granular soil or to 8 feet below the lowest drainage outlet in cohesive soil. Create wetlands by excavation to the elevation directed by the Engineer.

Restore borrow areas as shown on the plans or in a manner that will leave the land in a useful condition and with a natural appearance. Restore borrow areas within the right-of-way as required by the contract. Fence ponded borrow areas unless otherwise directed by the Engineer.

Restore borrow areas outside the right-of-way in accordance with permit requirements covered by Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act (MCL 324.9101 et seq.) and any land use agreements with the property owner.

The Engineer may allow boulders to remain in borrow areas if placement creates a natural appearance.

The Engineer may waive restoration requirements if the Contractor takes borrow from the working area of an existing commercial source or the property owner holds a permit from a county or municipal enforcing agency designated under Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act (MCL 324.9101 et seq.) Provide the Engineer with a copy of the property owner's permit.

3. **Winter Grading.** The Engineer will determine the winter grading limits. Remove ice and snow from the ground surface before placing embankment.

   Remove frozen material if the original ground contains more than 4 inches of frost within the limits of 1:1 slopes extending away from the finished shoulders to points of intersection with the original ground.

   Remove frozen material on a partially complete fill before placing more fill on the embankment. Stockpile frozen material in areas approved by the Engineer and outside the limits of earth disturbance until thawed. Use the thawed material in the embankment if it meets moisture requirements at the time of use.

4. **Placing and Compacting Embankment.** After preparing the ground area, construct embankments with sound earth and stones, broken rock, concrete, or masonry, except within the top 3 feet of embankment, or as allowed in the disposal of peat excavation material in accordance with subsection 205.03.D and subsection 205.03.P. Do not place frost heave textured materials in the top 3 feet of embankment below subgrade surface. Use a uniformly textured material to construct the top 3 feet of embankment to a uniformly

stable condition. Provide at least 50 feet of longitudinal transition between two types of textured materials.

Deposit embankment materials and compact in accordance with the controlled density method. The Engineer may direct or approve the 12-inch layer method, rock embankment method, or methods for the treatment of peat marshes.

Construct embankments using methods that do not create an unstable slope condition. Do not block the drainage of granular material by placing impervious material on the outside of embankments or by placing a combination of pervious and impervious material in the embankment, creating potential pockets of saturated material. Do not place peat excavation material in upland areas between the 1:1 slope that extends down from the subgrade surface/front slope intercept point and the final plan fill slope in fills greater than 14 feet high.

The Engineer may allow the placement of uncovered stones within construction limits, broken concrete, and broken rock from rock cuts in embankments. Use stones, broken concrete, and broken rock with the largest dimension no greater than 12 inches. Place in layers. Fill voids with sound earth and compact to at least 95% maximum unit weight. Do not place stones, broken concrete, or broken rock layers within 3 feet of the subgrade surface.

When placing embankment in layers of the required thickness is not feasible (e.g., filling in water, constructing on poorly drained soil), the Engineer may allow construction of the embankment in one layer of granular material Class III and will determine the minimum elevation for equipment operation. Thoroughly compact the fill material. Above the granular material Class III elevation, construct the embankment in accordance with the controlled density method.

Backfill and compact embankment adjacent to structures in accordance with subsections 205.03.I and 206.03.B. Construct other embankment and backfill as follows:

a. **Controlled Density Method.** Deposit cohesive material for embankments and spread in layers no greater than 9 inches deep, loose measure, and extending the full width of the fill area.

   For granular material, attain the required density by depositing, spreading, and compacting in layers no greater than 15 inches deep.

   Provide cohesive material with a moisture content no greater than 3% above optimum at the time of compaction. Provide granular material with a moisture content below saturation in accordance

with the one-point cone chart in MDOT's *Density Testing and Inspection Manual*.

Provide cohesive material in the top 3 feet of embankment with a moisture content not exceeding optimum at time of compaction. For material containing excess moisture, dry to the required moisture content before compacting. Ensure that each layer of material meets moisture requirements, and compact each layer to at least 95% of the maximum unit weight before placing the succeeding layer.

If the required percentage of maximum unit weight and the required moisture content are attained but the compacted material does not provide support for the subbase, the Engineer may direct the Contractor to dry the material by aeration and recompact. Aerate by disking or by manipulating the material using other methods approved by the Engineer.

b. **Twelve-Inch Layer Method.** Deposit the material and spread in layers no greater than 12 inches deep, loose measure, parallel to the finished grade, and extending to the full width of the embankment. Deposit the material by operating the hauling equipment over the layer being placed. Compact each layer to at least 95% of its maximum unit weight in accordance with the 12-inch layer method test in MDOT's *Density Testing and Inspection Manual.*

c. **Rock Embankment.** Use shattered rock from blasting or ripping with the largest dimension no greater than 12 inches to construct rock embankment. Deposit rock on the constructed fill and push over the leading edge to extend the fill. Do not deposit the shattered rock from the hauling equipment directly over the end of the fill. Place the rock embankment in layers no greater than 3 feet thick. Fill the surface of the rock embankment with rock fragments and rock fines to prevent infiltration of the earth embankment. Use granular material Class III to supplement insufficient rock fines to fill the surface of the rock embankment.

Do not use the aforementioned method in fills less than 4 feet deep. Do not place the stones and broken rock layers within 3 feet of the subgrade surface. For structures under rock embankment, provide at least 24 inches of granular material Class III along the sides and the top of structures before placing the rock embankment.

I. **Structure Embankment**

1. **Compaction of Original Ground**. In fill areas on which a structure is required, remove the topsoil from the area within the toes of slope in accordance with subsection 205.03.A.1. Compact the area to at least 95% of the maximum unit weight and at least 9 inches deep.

2. **Placing Structure Embankment.** Place and compact structure embankment to the limits shown on the plans before casting overlying footings. Protect structure embankments from freezing until placement of overlying footings.

   a. **Under Structure Footings Supported by Piling.** Construct structure embankment with granular material Class III within the limits shown on the plans. The Engineer may allow the use of sound earth as an alternate material when placed between April 1 and November 15. Use sound earth as defined in subsection 205.01 except that for rocks, the greatest dimension must be less than 3 inches. Deposit and compact structure embankment in accordance with the controlled density method.

   b. **Under Structure Footings for Which Piling is Not Specified.** Construct structure embankment with granular material Class III within the limits shown on the plans and deposit and compact in accordance with the controlled density method. Compact structure embankment to 100% of the maximum unit weight within the limits of 1:1 slopes, extending outward and downward from the bottom edges of the structure footings.

3. **Winter Grading for Structure Embankment.** Construct embankment during winter weather in accordance with subsection 205.03.H.3 except that before placing embankment to support a structure, remove ground containing frost within the limits of 1:1 slopes spreading outward in every direction from the bottom edges of structure footings. Stockpile frozen material until thawed outside the limits of earth disturbance in areas that are approved by the Engineer.

J. **Machine Grading.** Machine grading consists of light grading, 12 inches deep, to develop the cross section shown on the plans and includes the following:

1. Scarifying;

2. Plowing;

3. Disking;

4. Moving;

5. Compacting; and

6. Shaping the earth.

Loading or hauling material is not required for machine grading.

Grade ditches to drain runoff water. Grade intersections, approaches, entrances, and driveways as shown on the plans or as directed by the Engineer. Obtain the Engineer's approval before using excavation from ditches and roadbeds for shaping shoulders and adjacent fills.

K. **Ditch Cleanout.** Perform ditch cleanout to a depth of no greater than 2 feet based on a typical cross section shown on the plans. Include the following work:

1. Remove cattails, brush, and miscellaneous debris;

2. Remove trees with a diameter of less than 6 inches;

3. Blend ditch profiles to match the existing ditch; and

4. Remove soils/spoils from the project site.

L. **Temporary Railroad Crossing.** Construct temporary railroad crossings in accordance with subsection 107.20.

M. **Granular Blanket.** Excavate unstable soil in the slopes and backfill within the limits and to the depths shown on the plans or as directed by the Engineer. Dispose of excavated material in accordance with subsection 205.03.P.

For granular blanket, Type 1, backfill with granular material Class II.

For granular blanket, Type 2, dress the excavated area with a nominal 3-inch layer of granular material Class II before placing the drainage layer. Construct the drainage layer using one of the following:

1. A 2-inch layer of open-graded aggregate with geotextile blanket above and below;

2. A three-dimensional mesh with geotextile blanket above and below; or

3. Other geocomposite section approved by the Engineer.

Place at least a 12-inch layer of granular material Class II on the drainage layer to bring the slope and ditch section to the required elevation and cross section.

Construct underdrains adjacent to or as a part of the slope protection in accordance with section 404.

N. **Trimming and Finishing Earth Grade.** Construct the earth grade to the required grade. Remove exposed stones and rocks with a diameter greater than 3 inches.

Trim the subgrade to the grade shown on the plans. If a subbase is required, trim the subgrade to within 1 inch of the required grade. If a subbase is not required, trim the subgrade to within ¾ inch of the required grade.

Trim and shape the earth grade outside the subgrade to the required lines, grades, and cross sections. Finish slopes to Class B tolerance unless Class A tolerance is required.

Finish Class A slopes to within 1 inch of the average slopes shown on the plans. Make measurements at right angles to the slope.

Finish Class B backslopes to within 6 inches of the average slopes shown on the plans. Make measurement at right angles to the slope. Do not leave abrupt variations in the finished surface. Remove debris and unsuitable material.

Finish Class B fill slopes to within 2½ inches of the required grade and cross section from the outside shoulder line for 3 feet down the slope. Measure at right angles to the slope. Finish the remainder of the fill slope the same as a Class B backslope.

If trees or other obstacles do not interfere, round the tops of backslopes, bottoms of fill slopes, and other angles in the lines of the cross section to form vertical curves as shown on the plans or as directed by the Engineer. Make vertical curve transitions gradual such that they present a uniform and attractive appearance. The Contractor may omit vertical curves if constructing ditches in peat.

O. **Channel Excavation.** Trim, straighten, widen, deepen, or relocate the channel of a stream or watercourse. Remove and dispose of excavated material. Remove masonry and concrete structures in accordance with section 204. Complete work in the new channel before diverting the stream flow to the new channel. Maintain channels and keep free from debris until final acceptance of the channel.

P. **Disposing of Surplus and Unsuitable Material.** The Department assumes no legal obligation to ensure that the Contractor responsibly disposes of surplus and unsuitable material in accordance with this section. Permits must be obtained as necessary in accordance with subsection 107.02.

1. **Disposal Within the Right-of-Way.** Do not dispose of material, temporarily or permanently, beyond the normal plan fill slope across

regulated or unregulated wetlands or floodplains. The Engineer may allow disposal of material, including associated restoration material, within the right-of-way to fill low areas or flatten slopes at no additional cost to the Department.

2. **Disposal Outside the Right-of-Way.** Do not dispose of material, temporarily or permanently, in regulated or unregulated wetlands or floodplains. Prior to excavation, obtain written permission from the owner of the property including restoration requirements to be used for disposal outside the right-of-way and file the written permission with the Department. Dispose of material and restore areas in accordance with subsection 205.03.H.2 at no additional cost to the Department.

3. **Contractor Responsibility.** The Contractor is directly and solely responsible for disposal of surplus and unsuitable material.

   Contact the appropriate regulatory agencies to determine whether an area is a regulated or unregulated wetland or floodplain before disposing of surplus or unsuitable material in areas outside the right-of-way and not shown on the plans as disposal sites.

   Immediately move to an upland site any surplus or unsuitable material that was disposed of in portions of regulated or unregulated wetlands or floodplains not shown on the plans as disposal sites, at no additional cost to the Department. Restore the vacated area as directed by the applicable regulatory agencies at no additional cost to the Department.

   The Engineer will not consider requests for extensions of contract time without an assessment of liquidated damages for delays associated with moving surplus or unsuitable material to an upland site.

4. **Notification to Regulatory Agencies.** The Department will notify the applicable regulatory agencies if the Department becomes aware that the Contractor disposed of surplus or unsuitable material in portions of a regulated or unregulated wetland or floodplain not shown on the plans.

Q. **Berm Grading.** Remove existing earthen berms along shoulders of the roadway including under existing guardrail to facilitate drainage. Remove all berms from the paved shoulder to the hinge point of the fill slope and grade the slope to provide positive drainage or to the dimensions shown on the plans. Removed berm material, if approved for reuse, must be in accordance with subsection 107.15. Dispose of surplus or unsuitable material in accordance with subsection 205.03.P.

205.04. Measurement and Payment

Pay Item	Pay Unit
Excavation, Earth	Cubic Yard
Granular Material, Cl __	Cubic Yard
Excavation, Rock	Cubic Yard
Excavation, Peat	Cubic Yard
Backfill, Swamp	Cubic Yard
Subgrade Undercutting, Type __	Cubic Yard
Subgrade Manipulation	Square Yard
Embankment, LM	Cubic Yard
Embankment, CIP	Cubic Yard
Embankment, Structure, CIP	Cubic Yard
Machine Grading	Station
Ditch Cleanout	Station
Granular Blanket, Type __	Cubic Yard
Excavation, Channel	Cubic Yard
Berm Grading	Station

A. **Roadway Earthwork Volumes.** Prior to the start of the work, the Engineer and Contractor may agree to accept plan quantity, or the Engineer will calculate roadway earthwork volumes using the average end areas, the staked-section method, or an agreed-to alternative method.

The Engineer will determine the average end areas using the cross sections determined from the original and final elevation measurements. An alternative method such as a comparison of digital terrain models may be used if agreed to by the Contractor and the Engineer prior to the start of work.

For the staked-section method, the Engineer will calculate earthwork quantities by comparing the original cross sections taken before construction to the cross sections taken during and after construction.

The Engineer will take measurements during construction to verify conformance to the required grade and cross sections. The Engineer will adjust quantities for the following:

1. Changes in design;
2. Engineer-authorized deviation from the established grade and cross section;
3. Changes in original ground topography after the original survey was made; or

4. Any changes required by the Engineer during construction such as changing of cut or fill slopes and for excavation of peat, muck, marl, and very soft underlying clay.

B. **General.** The cost to build, maintain, remove, and restore borrow haul routes is included in the unit prices for other pay items.

The Engineer will measure removed topsoil and other selected excavated materials from embankment areas as **Excavation, Earth**.

If the progress clause in the contract requires the Contractor to construct embankments during the seasonal suspension, the Department will pay for the frozen material that is removed and the embankment that is required to replace it at the unit price for **Excavation, Earth** and **Embankment** of the type required. The Engineer will direct the grading limits during the seasonal suspension.

The Department will not pay for removing topsoil and frozen material to facilitate the Contractor's operations.

The unit prices for other pay items include the cost of compacting existing material in embankment and cut sections after removing topsoil.

The Department will pay for the removal of masonry and concrete structures in accordance with section 204.

The Engineer will measure **Granular Material, Cl II** and **Granular Material, Cl III** in place. The Engineer will measure **Granular Material, Cl III** required for constructing fills in water or constructing fills on poorly drained soil as **Backfill, Swamp**.

The Engineer will measure **Underdrains, Bank** in accordance with subsection 404.04.

The cost of trimming the subgrade and slopes to the required tolerances is included in the unit prices for other pay items.

The cost of restoring borrow and disposal areas is included in the unit prices for other pay items.

C. **Excavation, Rock.** The Engineer will measure **Excavation, Rock** using the staked-section method with no allowance for overbreak. The Department considers overbreak the material removed outside the area shown on the plans or the Engineer-approved cross section for rock excavation.

The Engineer will not make deductions for rock projecting inside the lines of the cross section within the limits required.

The Engineer will measure boulders greater than ½ cubic yard individually and will calculate the volume from average dimensions taken in three directions. The Department will pay for boulders greater than ½ cubic yard as **Excavation, Rock.**

The Engineer will measure the removal of overburden as **Excavation, Earth.**

D. **Peat Excavation and Swamp Backfill.** The Engineer will measure total **Excavation, Peat** in its original position.

For the measurement of partial **Excavation, Peat** and displacement, the Engineer will include the volume of the peat that is excavated to form the trench and the excavation of the upheaved peat in the trench. The Engineer will estimate the volume of upheaved peat required for removal from the trench at 100% of the actual peat displaced. The Department will not include peat displaced outside the pay limits shown on the plans in the pay quantity. The Engineer will take borings to determine the depth of displacement for calculating pay quantities.

The Department will pay for excavating peat, muck, marl, and very soft underlying clay as **Excavation, Peat.**

The unit price for **Excavation Peat** includes the cost of rehandling waste material to facilitate displacement.

In the treatment of peat marshes, the Department will not allow claims for delays lasting less than 60 days caused by Department testing and determination of corrective methods. Perform corrective work in areas requiring the total excavation method at no additional cost to the Department.

The Department and the Contractor will share equally the costs for corrective work in areas where the partial peat excavation and displacement method is required or directed by the Engineer. Payment for the corrective work includes excavation and relief trenches. If the Engineer recommends placement of a temporary surcharge, the Department will pay for half the swamp backfill quantity required for the surcharge. The Department will pay for half the quantity of swamp backfill removed as **Excavation, Earth** after the backfill stabilizes or the required settlement occurs.

If shown on the plans, the Department will pay for placement of temporary surcharge at the unit price for **Embankment, CIP** or **Backfill, Swamp.** The Department will pay for the removal of temporary surcharge at the unit price for **Excavation, Earth.**

The cost of maintaining a temporary surcharge, moved forward as the fill progresses, is included in the unit prices for other relevant pay items.

The Engineer will measure **Backfill, Swamp** in its original position. To facilitate measurement, isolate an area in the borrow pit or roadway cut as the exclusive source of material for **Backfill, Swamp**. If the Engineer requires more than initial and final cross sections to measure and calculate the volume of material removed, the Contractor must pay the Department for additional cross sections and calculations.

If not practical to calculate the volume of **Backfill, Swamp** in its original position, the Engineer will calculate the volume within the limits shown on the plans, or from fill borings, and increase the volume by 15%. The Engineer will not increase the **Backfill, Swamp** volume by 15% if the peat excavation results in a dry hole.

The Engineer will not increase the volume of **Backfill, Swamp** by 15% if the material is used to construct sand core fills regardless of whether sand core fills are shown on the plans or directed by the Engineer.

E. **Subgrade Undercutting and Subgrade Manipulation**

1. **Subgrade Undercutting.** The Engineer will measure **Subgrade Undercutting** in its original position. The Department will not make deductions to subgrade undercut quantities in areas where underdrain is installed.

   The Department will not adjust the unit price for changes to the quantity of the type of **Subgrade Undercutting** required.

   The unit price for **Subgrade Undercutting** of the type required includes the cost of removal and disposal of unsuitable material and replacement with required material.

   Payment for geotextile separator required for 4G backfill will be paid for according to subsection 308.04.

2. **Subgrade Manipulation.** The Engineer will measure **Subgrade Manipulation** only in designated areas shown on the plans or directed by the Engineer.

F. **Earth Excavation and Embankment.** The cost of stepping side slopes is included in the unit prices for the related roadway embankment pay items.

1. **Embankment, LM**. The Engineer will measure **Embankment, LM** by volume, loose measure. The unit price for **Embankment, LM** includes the cost of providing, hauling, placing, and compacting material at the required locations.

2. **Excavation, Earth and Embankment, CIP.** Payment for **Excavation, Earth** and **Embankment, CIP** will be based on subsection 205.04.A.

   If material is removed in embankment areas to a greater depth than required, the Department will pay only for the quantities of **Excavation, Earth**; **Embankment, CIP**; and **Embankment, Structure, CIP** as shown on the plans or as directed by the Engineer.

3. **Embankment, Structure, CIP.** The Engineer will measure **Embankment, Structure, CIP** based on the grade and cross section shown on the plans using the staked-section method. The Engineer will not make allowance for increases in quantities of fill material required due to normal consolidation of the natural ground under the embankment.

   The Engineer will measure sound earth if used as structure embankment under pile-supported footings as **Embankment, CIP**.

G. **Machine Grading.** The Engineer will measure **Machine Grading** along the surface edge. The Engineer will measure each side of the road where work is performed, separately.

H. **Ditch Cleanout.** The Engineer will measure **Ditch Cleanout** along the center line of the ditch. Restoration will be paid for separately in accordance with section 816.

I. **Granular Blanket**

   1. **Granular Blanket, Type 1.** The Engineer will measure **Granular Blanket, Type 1**, including the volume of granular material Class II, within the limits and to the depth shown on the plans or as approved by the Engineer.

   2. **Granular Blanket, Type 2.** The Engineer will measure **Granular Blanket, Type 2** in place and include the volumes of the drainage layer and granular material Class II within the limits and to the depth shown on the plans or as approved by the Engineer.

J. **Channel Excavation.** The Engineer will measure **Excavation, Channel** by volume in its original position.

K. **Berm Grading.** The Engineer will measure **Berm Grading** along the shoulder edge. The Engineer will measure each side of the road where work is performed, separately. The cost for berm grading under guardrail is included in this item. Grading under new or reconstructed guardrail is included in the unit price for the guardrail according to subsection 807.04.A.

Section 301. Subbase

301.01. Description

This work consists of constructing a granular subbase on a surface approved by the Engineer.

301.02. Materials

Provide material in accordance with the following section:

Granular Material Class II 902

301.03. Construction

Spread the subbase material evenly and compact to at least 95% of the maximum unit weight, at a less-than-optimum moisture content, for its entire thickness. Place the subbase in layers no greater than 18 inches. Where the required depth is more than 18 inches, place the material in layers of equal thickness. Construct the subbase to plan grade within a tolerance of plus 1 inch.

Do not place subbase on frozen, soft, unstable, or rutted subgrade. If subbase material becomes mixed with subgrade material, remove, dispose of, and replace the subbase material at no additional cost to the Department.

301.04. Measurement and Payment

Pay Item	Pay Unit
Subbase, LM	Cubic Yard
Subbase, CIP	Cubic Yard

A. **Subbase, LM.** The Engineer will measure **Subbase, LM** based on hauling unit dimensions and load count before placement and compaction. The unit price for **Subbase, LM** includes the cost of providing, hauling, placing, compacting, and grading the material.

B. **Subbase, CIP.** The Engineer will measure **Subbase, CIP** by the staked-section method as described in subsection 205.04. The unit price for **Subbase, CIP** includes the cost of providing, hauling, placing, compacting and grading the material.

Section 302. Aggregate Base Course

302.01. Description

This work consists of constructing an aggregate base course on a surface approved by the Engineer.

302.02. Materials

Provide materials in accordance with the following section:

Dense-Graded Aggregate 21AA, 21A, 22A..... 902

Provide aggregate meeting the aggregate series shown on the plans.

302.03. Construction

A. **Placing and Compacting.** Provide a ticket with each load stating the following information:

1. Project number;
2. Aggregate source;
3. Aggregate series;
4. Date;
5. Time;
6. Truck identifier number;
7. Supplier name; and
8. Type of aggregate approval.

If the contract requires payment by weight, ensure the ticket includes the gross weight, tare weight, and net weight to the nearest 100 pounds. Determine the truck tare weight at least once daily.

If the contract does not require payment by weight, the Engineer may accept written documentation instead of tickets. Written documentation must identify the pay item of the material and include all of the information listed above except time and truck identifier number.

Provide and place aggregate with a uniform gradation, free of contamination and segregation. Do not place aggregate base on frozen, soft, unstable or rutted subgrade, subbase, or aggregate base. Do not rut or distort the subbase material or aggregate base during spreading.

The Contractor may use additives to facilitate compaction, shaping, and maintenance of the aggregate surface.

Compact the aggregate layers to a uniform thickness, no less than 3 inches and no greater than 8 inches. If placing aggregate base in a layer less than 3 inches, blend the new aggregate base material with the layer below to ensure a total of 6 inches. Blending must be performed to ensure that the new aggregate base material is uniformly mixed with the layer below.

Compact each layer of aggregate base to at least 98% of the maximum unit weight at a moisture content no greater than optimum for aggregate base under hot mix asphalt (HMA) pavement. Compact each layer of aggregate base to at least 95% of the maximum unit weight at a moisture content no greater than optimum for aggregate base under concrete pavement. Within the limits of bridge approaches, from the abutment wall to the typical roadway cross section, compact each layer of the aggregate base to at least 98% of the maximum unit weight. Shape the finished surface and the layer thickness to within ±½ inch of the crown and grade shown on the plans.

Remove, dispose of, and replace aggregate base material that mixes with subbase or subgrade material at no additional cost to the Department.

B. **Conditioning Aggregate Base.** Shape the finished surface of the existing aggregate base course to within ±½ inch of the grade and cross section shown on the plans. Provide additional aggregate to address irregularities and obtain the required grade or cross section.

   If placing aggregate base in a layer less than 3 inches, blend the new material with the layer below to ensure a total of 6 inches. Blending must be performed to ensure that the new material is uniformly mixed with the layer below and compacted as specified in subsection 302.03.A.

C. **Maintenance During Construction.** Maintain the aggregate base course layer at the required line, grade, and cross section until placement of the next layer. Ensure the exposed aggregate base course layer remains smooth, compacted, and uncontaminated.

   If the subgrade, subbase, or aggregate base is damaged due to the Contractor’s operations or construction traffic, restore to the required condition at no additional cost to the Department.

D. **Surplus Existing Aggregate Base Material.** Surplus existing aggregate base material meeting the material requirements described in this section may be used instead of providing new aggregate base material. Remove and dispose of surplus aggregate base material not being used elsewhere on the project and any unsuitable material in accordance with subsection 205.03.P.

302.04. Measurement and Payment

Pay Item	Pay Unit
Aggregate Base	Ton
Aggregate Base, LM	Cubic Yard
Aggregate Base, __ inch	Square Yard
Aggregate Base, Conditioning	Station, Square Yard
Aggregate Base, Conditioning, Surplus and Unsuitable, Rem, LM	Cubic Yard
Salv Aggregate Base, Conditioning, LM	Cubic Yard

A. **Aggregate Base.** The Engineer will determine the moisture content and pay weights in accordance with section 109.

The Engineer will measure **Aggregate Base** by the scale weight of the material, including admixtures, and moisture content no greater than 8%.

The Engineer will perform moisture tests at the start of weighing operations and if construction operations, weather conditions, or other causes may change the moisture content of the material. If tests indicate a moisture content greater than 8%, the Engineer will deduct the weight of the excess moisture from the scale weight of the aggregate until moisture tests indicate the moisture content is no greater than 8%.

B. **Aggregate Base, LM.** The Engineer will measure **Aggregate Base, LM** based on hauling unit dimensions and load count before placement and compaction. The unit price for **Aggregate Base, LM** includes the cost of providing, hauling, placing, compacting, and grading the material and providing water for compaction.

C. **Aggregate Base, __ inch.** The Engineer will measure **Aggregate Base, __ inch** by width and length for the specified depth as shown on the plans.

D. **Aggregate Base, Conditioning.** If the contract requires payment for **Aggregate Base, Conditioning** in station pay units, the Engineer will measure along the alignment of the roadway.

If the contract requires payment for **Aggregate Base, Conditioning** in area pay units, the Engineer will measure by the width and length shown on the plans.

If the contract does not include the pay item **Aggregate Base, Conditioning**, the Department will consider the cost of conditioning aggregate base and of providing additives and water for compaction and maintenance to be included in other aggregate base pay items.

E. **Aggregate Base, Conditioning, Surplus and Unsuitable, Rem, LM.** The Department will pay for **Aggregate Base, Conditioning, Surplus**

and Unsuitable, Rem, LM only if the Contractor removes material from the project site and disposes of it in accordance with subsection 205.03.P.

F. **Salv Aggregate Base, Conditioning, LM.** The Department will pay for **Salv Aggregate Base, Conditioning, LM** for use in other areas of the project only if existing aggregate base material requires loading and hauling. The Engineer will measure and the Department will pay for as **Salv Aggregate Base, Conditioning, LM** surplus material that is loaded and hauled from locations on the project to other locations in order to attain the plan grade or cross section. The Engineer will measure the material in its final location.

Section 402. Storm Sewers

402.01. Description

This work consists of constructing storm sewers of the size and class required, including excavation, bedding, and backfill.

The following terms apply to this section:

Type HE. An elliptical pipe placed with the major axis in the horizontal direction.

Type VE. An elliptical pipe placed with the major axis in the vertical direction.

402.02. Materials

Provide materials in accordance with the following sections:

Granular Material Class II, III, IIIA 902
Aggregate 6A, 17A, 34R, 46G 902
Sewer Pipe 909
Sealers for Sewer Joints 909
Steel Pipe (for jacking in place) 909
Geosynthetics 910
Concrete, Grade 3000 1004
Mortar, Type R-2 1005

Select pipe with watertight joint systems from the Qualified Products List.

Storm sewers are divided into five classes, as specified in Table 402-1. If the contract specifies only the size and class of sewer, select and provide an alternative storm sewer pipe allowed in Table 402-1.

For types of sewer material that are required but are not included in Table 402-1, the contract will specify the type and size of sewer material.

A higher strength or greater thickness of sewer may be substituted for the minimum required sewer strength or minimum required thickness.

Table 402-1: Pipe Alternatives for Storm Sewer Classes

Type of Pipe	Storm Sewer Class (depth of cover, feet[a])				
	Class A Sewer (1–10)[b][c]	Class B Sewer (>10–16)	Class C Sewer (>16–23)	Class D Sewer (>23–33)[c]	Class E Sewer (1–3)[c][d]
Reinforced concrete[e]	II	III	IV	V	IV
Nonreinforced concrete[f]	1	3	No	No	No
Corrugated and spiral ribbed al-alloy[g]	Yes	Yes	Yes	Yes	No
Corrugated and spiral ribbed steel[h]	Yes	Yes	Yes	Yes	No
Dual-wall polymer-precoated galvanized steel	Yes	Yes	Yes	Yes	No
Smooth-lined corrugated plastic (CPE)[i]	Yes[j][k]	Yes[k][l]	No	No	No
Corrugated polyvinyl chloride (CPV)[m]	Yes[j][k]	Yes[k][l]	No	No	No

(a) Cover, including the pavement structure is defined as the height of fill above the top of the pipe measured to final grade.

(b) Class A sewer applies when the sewer is outside the influence of proposed pavement or is beneath the influence of proposed pavement and the depth of cover is >3 feet but ≤10 feet.

(c) Special design is required for depths of cover <1 foot and >33 feet.

(d) Class E Sewer applies when the sewer is beneath the influence of proposed pavement and the depth of cover is ≤3 feet.

(e) Roman numerals refer to class of reinforced concrete pipe in accordance with AASHTO M170.

(f) Arabic numerals refer to the class of nonreinforced concrete pipe in accordance with AASHTO M86.

(g) Allowed for 12- to 66-inch spiral ribbed and 12- to 18-inch helically corrugated 2⅔ by ½ inch aluminum alloy pipe only.

(h) Allowed for 12- to 84-inch spiral ribbed and 12- to 18-inch helically corrugated 2⅔ by ½ inch steel pipe only.

(i) Provide CPE in accordance with AASHTO M294, Type S polyethylene pipe.

(j) Allowed only for 36-inch-diameter pipe and under for CPE and CPV pipes. At least 3 feet of cover.

(k) Refer to the Class A, B and F Bury Plastic Pipe Qualified Products List for approved manufacturers and products.

(l) Allowed only for 12- to 24-inch diameter CPE and CPV pipes.

(m) CPV must conform to AASHTO M304.

402.03. Construction

A. **Excavation, Trench Construction, and Sewer Bedding.** Perform trench construction using methods that meet the health and safety requirements specified in subsection 104.07.

Excavate the trench as shown on the plans or as determined by the Engineer. Construct the trench width to at least the minimum width shown in the *MDOT Standard Plan R-83* series and wide enough to provide free working space and allow compaction of the backfill around the pipe. Shape the bottom of the trench to support the pipe uniformly. Place bedding using uncompacted granular material Class IIIA to the required elevation.

Where unstable soil conditions or obstructions other than rock require excavation of the trench below the elevation detailed on the plans, undercut, backfill, and compact the trench as directed by the Engineer. Use 6A, 17A, 34R, or 46G aggregate as backfill material for undercutting due to unstable soil conditions. Use 34R aggregate for bedding material instead of granular material Class IIIA. Place the backfill up to 4 inches below the proposed bottom of the pipe. The completed work will be paid for as Trench Undercut and Backfill according to subsection 402.04.E.

During sewer construction, maintain and protect existing live utilities. Minimize service interruptions and coordinate with the local municipality or utility company. Immediately repair or replace utilities interrupted during sewer construction as directed by the Engineer.

B. **Repair of Damaged Coated Surfaces.** Repair coated pipe surfaces damaged during pipe transportation, handling, or installation, at no additional cost to the Department. Complete repair of galvanized pipe surfaces in accordance with subsection 716.03.E or as approved by the Engineer. Repair other coated sewer pipe surfaces as directed by the Engineer.

C. **Laying and Jointing Pipe.** Lay storm sewers as shown on the plans with bells or grooves upgrade and ends fully and closely jointed. Provide a full, firm bearing along the length of each pipe section. Wrap all pipe joints with geotextile blanket. Use geotextile at least 36 inches wide and center it on the joint. Overlap the ends of the geotextile blanket at least 12 inches.

Remove and replace pipe damaged by Contractor operations. After trench backfill and compaction is complete, mandrel test replaced CPE and CPV pipe. Remove and re-lay sewer sections showing signs of settlement or poor horizontal or vertical alignment as determined by the Engineer at no additional cost to the Department.

1. **Corrugated Plastic Pipe (CPE and CPV).** Provide homing marks on CPE and CPV pipe sections and joint material to show the correct alignment of the pipe sections and joint material during field installation.

   After trench backfill and compaction is complete, the Engineer will select at least 50% of the installed length of each size of CPE and CPV pipe for deformation testing. Provide the labor and equipment that are required to complete the testing.

   Unless otherwise approved by the Engineer, perform the mandrel test within 10 work days prior to pavement surfacing or completion of final grade.

   Use a nine-point mandrel with a diameter equal to 95% of the nominal pipe diameter. Provide the Engineer with a proving-ring to verify the mandrel size. Pull the mandrel through the pipe by hand using non-mechanical means and without damaging the pipe. The Contractor may use laser profile technology to measure deflection as an approved alternative to mandrel testing.

   Remove and reinstall or replace pipe with a nominal diameter reduced by at least 5% at no additional cost to the Department. Reinstall only undamaged pipe. Do not reinstall pipe without the Engineer's approval.

   The Contractor is responsible for all expenses and delays caused by reinstallation or replacement of pipe.

2. **Concrete Pipe.** Install reinforced concrete elliptical pipe with the longer axis placed horizontally unless otherwise required.

   Install Type HE elliptical pipe with the longer axis within 5 degrees of horizontal.

   Install Type VE elliptical pipe with the longer axis within 5 degrees of vertical.

   Install circular concrete pipe with elliptical reinforcement so the lift holes or manufacturer's marks are on the top of the pipe. Place pipe so the lift holes or manufacturer's marks designating the top and bottom of the pipe are no more than 5 degrees from the vertical plane through the longitudinal axis of the pipe. After installing the pipe, seal the lift holes with concrete plugs and waterproof.

3. **Metal Pipe.** Provide metal pipe with helical corrugations with a continuous lock seam in accordance with subsection 909.05.

Use of dissimilar types of base metal (steel or aluminum alloy) or dissimilar types of coatings on steel (zinc or aluminum) in a single line of pipe is prohibited. Construction between dissimilar metal type pipes is not allowed unless a drainage structure is used to transition between the two dissimilar type metals. Changing materials at the drainage structure is allowed if the roughness coefficients have been adjusted accordingly. Use coupling bands of the same base metal and coating metal as the pipe.

D. **Sewer Taps.** Make connections to storm sewers owned by counties, municipalities, or drain commissions in accordance with the regulations of the owner and as required by the contract. If a conflict exists between the owner's regulations and these specifications, the owner's regulations will take precedence.

For existing storm sewers with plugs or bulkheads, remove plugs or bulkheads without damaging the existing sewer and make watertight joint connections. Remove material in accordance with subsection 204.03.B.

If tapping an existing pipe, cut an opening in the receiving pipe at least 6 inches larger than the outside diameter of the inlet pipe. Insert the inlet pipe and cut flush with the inner wall of the receiving pipe. Pack a layer of mortar at least 3 inches thick around the inlet pipe and strike smooth with the inner wall of the receiving pipe. Encase the inlet pipe on the outside of the connection with concrete to provide bearing under the pipe. Repair or replace existing pipe damaged by Contractor tapping operations at no additional cost to the Department.

Do not direct tap sewer inlet pipes with outside diameters greater than half the inside diameter of the trunk sewer. Construct a manhole structure for these taps in accordance with section 403. Obtain the Engineer's approval before using other methods of tapping existing sewers.

E. **Sewer Bulkheads.** Construct sewer bulkheads using Grade 3000 concrete or brick or block masonry. Extend the bulkhead at least 1 foot into the pipe from the inner wall of the drainage structure. Construct masonry bulkheads in accordance with subsection 403.03.A.

F. **Backfilling.** Backfill in accordance with subsection 401.03.D.

G. **Sewer Jacked in Place.** Jack sewers in place in accordance with subsection 401.03.G.

H. **Disposal of Surplus Material.** Take possession and dispose of surplus material in accordance with subsection 205.03.P.

I. **Cleanout.** Maintain storm sewers installed on the project. Verify that installed sewers are free of silt, debris, and other deleterious material at the time of final acceptance and in accordance with section 209.

J. **Video Inspection of Sewer Pipe.** Use closed circuit television to inspect required storm sewers. Dewater or divert flow in sewers for inspection. Video inspection is not required for extensions of existing catch basin leads less than 20 feet.

After backfilling and compacting the trench, and within 10 working days prior to pavement surfacing or completion of final grade, conduct the inspection of sewers under pavement unless otherwise approved by the Engineer.

For sewers not under pavement, after backfilling and compacting the trench, conduct the inspection as close to project completion as possible but allow time for corrective action as determined by the video inspection and directed by the Engineer.

1. **Traffic Control.** Obtain the Engineer's approval of traffic control measures at least 5 days before beginning work. Propose a traffic control plan in accordance with the *Michigan Manual of Uniform Traffic Control Devices* (MMUTCD) and the maintaining traffic plans in the contract.

   Unless otherwise approved by the Engineer, keep traffic lanes open. For necessary lane or shoulder closures, use traffic control measures in accordance with the traffic control plan.

2. **Equipment.** Use a camera designed and constructed for inspecting sewers and equipped with the following features:

   a. A pan and tilt head external to the main body of the camera to allow inspection of the sewer joints and cracks or other defects;

   b. Lighting to allow a clear picture of the perimeter of the pipe; and

   c. Underwater operation capable of producing a picture quality that is satisfactory to the Engineer.

   d. Show or document camera magnification at all times in the video.

   If the Engineer determines the video quality is not satisfactory, re-inspect the pipes to obtain acceptable results at no additional cost to the Department.

   Use continuous running video capable of recording audio and video information. Include the date (month, day, and year) and camera location. Provide a continuous record of the sewer section from manhole to manhole or from end to end. Use high quality, color, digital

format at a standard play speed. Obtain the Engineer's approval before using other recording media.

3. **Sewer Flow Control.** For video inspection, provide flow control to bring the depth of flow in the sewer pipe to within the range specified in subsection 402.03.J.6.a. Before starting work, submit the proposed method of sewer flow control to the Engineer for approval.

    a. **Depth of Flow.** Lower the depth of flow in the sewer during the videotaping operation to less than 2 inches. Reduce flow by plugging or blocking the flow or by pumping the flow and bypassing the pipe section during inspection, as approved by the Engineer.

    b. **Plugging or Blocking.** Insert a sewer line plug into the line upstream of the section undergoing inspection. Use a plug designed to allow the release of portions of the flow. During video inspection, reduce the flow depth to 2 inches. Restore normal flow after completing the work. Meter flow discharge to prevent erosion.

    c. **Pumping and Bypassing.** For pumping and bypassing, supply the pumps, conduits, and other equipment to divert the flow around the sewer section undergoing inspection. Provide a bypass system with a capacity to handle existing flow plus additional flow that may occur during a rain event. Provide the labor and supervision required to set up and operate the pumping and bypassing system.

    d. **Flow Control Precautions.** If the flow in a sewer line is plugged, blocked, or bypassed, protect the sewer lines from damage that may result from sewer surcharging. Do not cause flooding or damage to public or private property while controlling sewer flow.

4. **Procedure.** Move the camera through the line at a rate no greater than 0.5 feet per second, stopping as required to document the joint and pipe conditions. Use winches, cable, powered rewinds, or other devices that do not obstruct the camera view or interfere with proper documentation of the pipe conditions.

    Adjust the camera to travel above the level of the flow in the pipe. If the camera encounters a dip in the pipe such that the water rises above the springline of the pipe or if the camera lens becomes submerged, withdraw the camera and re-insert it from the other end as far as possible. Do not back the camera into a pipe undergoing inspection.

    Measure the distance to the location of defects above ground using a meter device. Marking defect locations on the cable to measure the

distance to defects is not allowed. Provide a distance meter with an accuracy within 1 foot and check using a walking meter, roll-a-tape, or other device.

5. **Documentation.** Provide the inspection to the Engineer in a digital format. Include a written log of damages or installation defects, including pipe deformation, cracking, joint separation, corrosion, perforation, and other features identified in the video. Provide a digital copy of the log to the Engineer. Locate the damage or defect by meter marking of the video in the inspection log. Label the videos to describe the reaches of sewer or culverts contained in the videos, including street location and manhole numbers. If manhole numbers are not provided, assign a numbering system to allow identification in the inspection report and video.

402.04. Measurement and Payment

Pay Item	Pay Unit
Sewer, Cl __, __ inch, Tr Det __	Foot
Sewer, Reinf Conc Ellip, (shape) Cl __, (rise) by (span) inch, Tr Det __	Foot
Sewer, Cl __, __ inch, Jacked in Place	Foot
Sewer Tap, __ inch	Each
Sewer Bulkhead, __ inch	Each
Trench Undercut and Backfill	Cubic Yard
Dewatering System, Trench	Foot
Video Taping Sewer and Culv Pipe	Foot

A. **Sewer and Sewer, Reinforced Concrete Elliptical.** The Engineer will measure **Sewer** and **Sewer, Reinf Conc, Ellip** of the size, class, and trench detail required, in place from center to center of manholes, catch basins, or inlets. The unit price for **Sewer** and **Sewer, Reinf Conc, Ellip** includes the cost of excavation, backfill, and geotextile blanket.

B. **Sewer, Jacked in Place.** The Engineer will measure **Sewer, Jacked in Place** of the size and class required, by length, as determined by multiplying the number of units jacked by the commercial laying length. The unit price for **Sewer, Jacked in Place** includes the cost of excavating the pit; providing and installing sheeting, bracing, and other safety devices; providing jacking equipment; drainage and dewatering; and other items associated with the operation.

C. **Sewer Tap.** The Engineer will measure **Sewer Tap** based on the inlet pipe size required, by each tap into an existing system. If tapping an existing sewer line using a drainage structure, the Department will pay for one sewer tap in addition to the drainage structure.

D. **Sewer Bulkhead.** The Engineer will measure only sewer bulkheads for storm sewers with a diameter larger than 12 inches. The cost of constructing sewer bulkheads for pipes with a diameter less than or equal to 12 inches or constructed as part of abandoning or removing drainage structures as shown on the plans is included in the unit prices for related pay items.

   The Department will pay separately for bulkheading pipes greater than 12 inches.

E. **Trench Undercut and Backfill.** The Engineer will measure **Trench Undercut and Backfill** by calculating the volume from the length, depth, and width of undercut authorized by the Engineer and shown on the plans. The Engineer will not make allowance for sloping the sides of the trench. The unit price for **Trench Undercut and Backfill** includes the cost of excavation and disposal of material and providing, placing, and compacting 6A, 17A, 34R, or 46G aggregate to the bottom of trench elevation shown on the plans.

F. **Rock Excavation.** The Engineer will measure and the Department will pay separately for rock excavation in accordance with subsection 205.04.

G. **Dewatering System, Trench.** If the contract does not include a pay item for **Dewatering System, Trench** and the Contractor uses a dewatering system, the Department will not pay separately for the system but will consider the cost to be included in the unit price for related pay items.

H. **Trenchless.** The Engineer may authorize trenchless methods, in place of open-cut construction methods. The Department will delete or proportionally reduce pay item quantities required for corresponding open-cut construction from the contract if the Engineer authorizes trenchless methods. The Department will not make an adjustment in the pay items of **Minor Traf Devices** or **Traf Regulator Control.**

   Payment for the work performed by trenchless methods will not exceed the unit price bid for the open-cut method.

   If the Engineer authorizes trenchless installation, **Obstructions** will be removed in accordance with subsection 718.03.F.2. Additional payment or delays for removal of obstructions will not be considered.

I. **Video Taping Sewer and Culvert Pipe.** The unit price for **Video Taping Sewer and Culv Pipe** includes the cost of dewatering, flow control, video inspection, and documentation.

   The Department will pay separately for traffic maintenance and control in accordance with subsection 812.04.

J. **Obstructions.** Engineer will measure, and the Department will pay for the removal of obstructions, which require the use of special procedures at the unit price for **Obstruction Removal** in accordance with subsection 718.04.D.

Section 403. Drainage Structures

403.01. Description

This work consists of adjusting, constructing, or temporarily lowering drainage structures and cleaning existing drainage structures and leads as directed by the Engineer.

Drainage structures include manholes, catch basins, leaching basins, inlets, and drop inlets.

Drainage Structure. Includes concrete footing or precast sump. Used for access to new or existing sewers with a diameter no greater than 48 inches.

Manhole Base, Type 1 or Type 2, and Manhole Riser. Used for access to new or existing sewers with a diameter of at least 48 inches. Manhole Base Type 1 may be substituted for Precast Manhole Tees. **Precast Manhole Tee and Manhole Riser.** Used for access to new sewers with diameters of at least 42 inches.

Manhole Base, Type 1 or Type 2, and Manhole Riser. Used for access to new or existing sewers with a diameter of at least 48 inches. Manhole Base Type 1 may be substituted for **Precast Manhole Tees**.

403.02. Materials

Provide materials in accordance with the following sections:

Granular Material Class II, III 902
Steel Reinforcement 905
Miscellaneous Metal Products 908
Castings 908
Culvert, Sewer Pipe, and Box Sections 909
Geosynthetics 910
Masonry Units 913
Concrete, Grade 3000 1004
Mortar Type R-2 1005

Provide cast-in-place or precast concrete construction for sanitary sewer manholes.

Provide structural steel plate, at least ½ inch thick, for temporary lowering of drainage structures that span 72 inches or less. Verify that plates cover the entire drainage structure with a bearing surface of at least 12 inches. For plates that span greater than 72 inches, submit structural calculations prepared by a Professional Engineer licensed in the State of Michigan to the Engineer.

Provide leveling course hot mix asphalt (HMA) for patching during the temporary lowering operations or other HMA mixture as approved by the Engineer.

403.03. Construction

A. **Constructing, Adjusting, and Temporary Lowering of Drainage Structures, Precast Manhole Tees, Manhole Bases, and Manhole Risers**

1. **Excavation.** Excavate for constructing, adjusting, and temporarily lowering drainage structures, precast manhole tees, manhole bases, and manhole risers in accordance with subsection 206.03.A.

2. **Concrete Construction.** Construct concrete portions of drainage structures in accordance with subsection 706.03. Do not cast drainage structures if the concrete temperature is above 90°F.

3. **Placing Brick and Block Masonry.** Do not place masonry with mortar when the ambient air temperature is 36°F or less unless approved by the Engineer. Remove and replace work damaged by frost. Apply a ½-inch-thick plaster coat of mortar to the outer surface of structures and to the inner surface below the outlet flow line on catch basins with traps or sumps. Place the first set of bricks or blocks on a full bed of mortar. Lay brick or block in courses with uniform mortar joints ½ inch thick within ⅛ inch of depth. Stagger joints by half the length of the brick or block on adjoining courses. Place courses level unless otherwise required. Strike and point joints so the exposed surface is smooth. Rake joints and wet brick or block before placing the plaster coat. Allow the brick or block surface to dry to provide for proper bonding of the plaster coat.

   Wet the brick. Allow the brick surface to dry to allow the brick and mortar to bond. Use of broken or chipped brick on the faces of the structure is prohibited. Provide a course made of headers at least every seventh course. Make closures with brick lengths no less than the width of a whole brick.

4. **Precast Reinforced Concrete Units.** Use poured-in-place concrete in accordance with subsection 403.03.A.2 or precast concrete footings. Construct precast reinforced concrete units in accordance with the contract. Seal the joints with mortar in accordance with subsection 403.03.A.3, or use butyl rubber sealant that conforms to ASTM C990. Support precast concrete footings on a 6-inch subbase of compacted granular material Class II.

5. **Steel Reinforcement.** Install steel reinforcement in accordance with subsection 706.03.

6. **Inlet and Outlet Pipes.** Place and compact backfill around the manhole base or sump to provide bedding for inlet and outlet pipes.

   Extend inlet and outlet pipes through the outside wall surface of the manhole a sufficient length to allow for pipe connections. Construct masonry around pipes and seal with mortar or other product approved by the Engineer to prevent leakage.

7. **Backfilling.** Backfill in accordance with subsection 401.03.D.

   Stage backfilling to coordinate with the construction sequencing of the structure as necessary.

8. **Temporary Lowering of Drainage Structures.** Lower drainage structures before milling the pavement.

   Record the location of the structure so each cover can be reinstalled at its original location. Remove the existing frames and covers and match mark them for later identification and placement. Salvage and safely store frames and covers. Repair the existing structure to allow uniform contact of the steel plate to the top of the structure. Place and compact the HMA for patching in accordance with section 501.

9. **Protection during Construction.** Install inlet protection devices in accordance with section 208 and as approved by the Engineer when working around the drainage structure.

B. **Drainage Structure Covers.** Provide and install new covers, including frames and grates, on new or existing structures as required. Place castings on a full mortar bed.

C. **Adjusting Drainage Structure Covers.** Adjusting drainage structure covers applies when the new elevation of the cover requires a vertical change of no greater than 6 inches. Before placing the HMA top course or overlay, make final adjustments to drainage structure covers within the HMA pavement section if only applying one course. Adjust the cover to the required elevation by supporting it on one of the following:

   1. Metal ring adjustor;

   2. Precast concrete adjusting ring;

   3. Masonry in a full mortar bed; or

   4. Alternate adjustor selected from the Qualified Products List.

Hold adjusted covers in place. Remove and replace the adjacent pavement, curb, or curb and gutter to match the existing grades or the required new elevations.

D. **Additional Depth of Adjusting Drainage Structures.** Additional depth of adjusting drainage structure covers applies when a drainage structure cover is adjusted more than 6 inches from the existing cover elevation due to a change in elevation of the roadway or when alterations to the drainage structure exceed 6 inches regardless of the change in cover elevation. Remove damaged or unsound portions of the structure as directed by the Engineer and adjust as required.

E. **Drainage Structure Taps.** Make connections to existing drainage structures owned by counties, municipalities, or drain commissions in accordance with the owner's regulations and the contract. If a conflict exists between the owner's regulations and these specifications, the owner's requirements take precedence.

If tapping an existing drainage structure, cut an opening into the receiving structure at least equal to the outside diameter of the inlet pipe plus 6 inches and insert the pipe. Pack a layer of mortar at least 3 inches thick around the inlet pipe and strike smooth with the inner wall of the receiving structure. Repair or replace existing drainage structure damaged by Contractor operations during tapping at no additional cost to the Department.

Tap directly to a sewer or culvert in accordance with subsection 402.03.D.

F. **Cleanout.** Maintain catch basins, manholes, leaching basins, and inlets installed on the project. Ensure that installed catch basins, manholes, leaching basins, and inlets are free of silt, debris, and other deleterious material at the time of final acceptance.

G. **Cleaning Existing Drainage Structures and Leads.** Before the Contractor starts work, the Engineer will determine the condition and identify the areas on the project that require cleaning of existing drainage structures and leads.

First, clean the downstream drainage structure nearest the trunk sewer and place a temporary bulkhead so the trunk sewer remains clear. Clean upstream drainage structures and leads only after cleaning and bulkheading the downstream drainage structure.

Clean the drainage structures and leads of sand, silt, and debris and prevent further contamination of the leads.

Dispose of the waste generated from the drainage structure or drainage structure lead cleanout operation using either Disposal Alternative A or Disposal Alternative B in accordance with this subsection.

If the Contractor suspects the waste generated is non-hazardous contaminated material or hazardous contaminated material, notify the Engineer. If testing shows the material is a hazardous waste as defined in Part 111, Hazardous Waste Management, of the Natural Resources and Environmental Protection Act (Michigan Compiled Laws [MCL] 324.11101 et seq.), immediately notify the Engineer.

1. **Disposal Alternative A**

   a. **Solid Waste Phase.** Solid waste disposal rules require that the waste have no releasable liquids. Dispose of the solid waste at a Type II landfill. The landfill may require testing before accepting the waste. Provide disposal documentation from the Type II landfill to the Engineer.

   b. **Liquid Waste Phase.** Dispose of the liquid waste using one of the following options:

      Option 1 – Evaporate the liquid waste by use of drying beds, decanting stations, or similar systems that contain the solids during evaporation.

      Option 2 – Place liquid waste in a sanitary sewer system with the sanitary sewer owner's approval. Provide a copy of the owner's approval to the Engineer.

      Option 3 – Pump the majority of clear liquid from the drainage structure and leads without disturbing the solids. Discharge the clear liquid to:

      i. A sanitary sewer or combined sanitary and storm system with the sewer owner's approval;

      ii. The curb and gutter such that it re-enters and is completely contained within the storm sewer system and does not directly discharge into the waters of the state; or

      iii. An area of undisturbed, well-vegetated ground at a rate that does not result in excessive ponding, runoff, or soil erosion.

      Dispose of the remaining solid and liquid phase as waste using Disposal Alternative A, either Option 1 or Option 2, or Disposal Alternative B.

2. **Disposal Alternative B.** Use a Licensed Liquid Industrial Waste Hauler to transport the waste generated and dispose of it in

accordance with Part 121, Liquid Industrial By-Products, of the Natural Resources and Environmental Protection Act (MCL 324.12101 et seq.). Provide the Engineer with a copy of the transport manifest.

403.04. Measurement and Payment

Pay Item	Pay Unit
Dr Structure, __ inch dia	Each
Dr Structure, Add Depth of __ inch dia, 8 foot to 15 foot	Foot
Dr Structure, Add Depth of __ inch dia, more than 15 foot	Foot
Drop Inlet, Type __	Each
Mh, Precast Tee, Cl __, __ inch	Each
Mh Base, __ inch, Type __	Each
Mh Riser	Foot
Dr Structure Cover, Type __	Each
Dr Structure Cover, Adj, Case __	Each
Dr Structure, Adj, Add Depth	Foot
Dr Structure, Tap, __ inch	Each
Dr Structure, Temp Lowering	Each
Dr Structure, Cleaning	Each
Dr Structure Lead, Cleaning, __ inch	Foot

A. **Drainage Structures Excluding Drop Inlets.** The Engineer will measure the depth of drainage structures, with the exception of drop inlets, from the top of the masonry to the top of the concrete footing.

The unit price for **Dr Structure** of the diameter required includes the cost of concrete footing and no greater than 8 feet of the drainage structure depth. The unit price for **Dr Structure** includes the cost of temporary or final grade adjustments of the structure.

The unit price for **Dr Structure, Add Depth, 8 foot to 15 foot** of the diameter required includes the cost of drainage structure portions greater than 8 feet deep but no greater than 15 feet deep.

The unit price for **Dr Structure, Add Depth, more than 15 foot** of the diameter required includes the cost of drainage structure portions greater than 15 feet deep.

The unit price for new structures includes the cost of cleaning new drainage structures.

B. **Drop Inlets.** The Engineer will measure drop inlets as units, of the type required, regardless of depth.

The Department will pay separately for pipe leading from the drop inlet to a sewer or catch basin. The cost of pipe from drop inlets, Type 1, is included in the unit price for related sewer pay items in accordance with

subsection 402.04. The cost of pipe from drop inlets, Type 2, as shown in the special detail, is included in the unit price for the related sewer pay item.

The Department will pay for a sewer tap or drainage structure tap in accordance with subsection 402.04 only if tapping the sewer or encased sewer into an existing drainage system is required.

C. **Manhole Base and Riser.** The Engineer will measure **Mh Riser** vertically from above the collar of the **Mh, Precast Tee** or above the **Mh Base** to the top of the riser.

The unit price for **Mh Base, Type 1** includes the cost of cutting access holes in the sewer.

If the Contractor uses **Mh Base, Type 1** in place of **Mh, Precast Tee,** and the contract does not include the pay item **Mh Base, Type 1**, the unit price for **Mh, Precast Tee** includes the cost of installing a Type 1 manhole base.

D. **Drainage Structure Covers.** When new covers are placed on existing structures, the Engineer will measure and the Department will pay for **Dr Structure Cover, Adj, Case __** in addition to the new cover.

The unit price for **Dr Structure Cover, Adj, Case 1** includes the cost of the following:

1. Sawcutting existing pavement, curb, and curb and gutter;
2. Adjusting the cover up or down no greater than 6 inches; and
3. Removing and replacing pavement adjacent to the adjusted cover in accordance with the *MDOT Standard Plan R-37* series.

The Department will pay separately for removing and replacing curb and gutter adjacent to the adjusted structure.

The Department will pay only for **Dr Structure Cover, Adj, Case 2** for structure adjustments located outside existing pavement, curb, and curb and gutter.

The unit price for **Dr Structure Cover, Adj** of the case required includes the cost of repairs for uniform contact of temporary steel plate to the top of structures.

The Engineer will measure **Dr Structure, Adj, Add Depth** of the required diameter and depth beginning 6 inches from the level of the existing structure, in the direction of adjustment, to the limit of the additional adjustment depth. If the contract includes a pay item for **Dr Structure, Adj, Add Depth,** the contract will also include a pay item for **Dr Structure**

Cover, Adj of the case required. The unit price for **Dr Structure, Adj, Add Depth** includes the cost of drainage structure taps within the limits of the adjustment.

The Department will pay for drainage structure taps outside the limits of the adjustment as **Dr Structure, Tap**. The Department will pay for taps to existing sewers as **Sewer Tap** of the size required, in accordance with subsection 402.04.

E. **Drainage Structure, Temporary Lowering.** The unit price for **Dr Structure, Temp Lowering** includes the cost of the following:

1. Match marking;
2. Removing, salvaging, and transporting castings to and from the site;
3. Storing the existing structure castings;
4. Plating the structure;
5. HMA patching; and
6. Removing the plate and HMA patching materials for final adjustment.

The Department will pay separately for the final adjustments to drainage structures. The unit price for **Dr Structure Cover, Adjust, Case 1** includes the cost of removing pavement to lower the structure.

The cost of repairs is included in the unit price for the related drainage structure adjustment pay item.

F. **Cleaning Existing Drainage Structures and Leads.** The unit price for **Dr Structure, Cleaning** includes the cost of testing for disposal, hauling, and disposing of generated waste.

The unit price for **Dr Structure Lead, Cleaning** of the size required includes temporary bulkheads and the cost of testing for disposal, hauling, and disposing of generated waste.

The cost for cleaning out existing sewers, plugged by Contractor operations, is included in related pay items.

If not included in the contract, the Department will pay for disposal of non-hazardous contaminated material and hazardous contaminated material in accordance with subsection 109.05.

Section 404. Underdrains

404.01. Description

This work consists of constructing and installing underdrains, foundation underdrains, and underdrain outlets.

404.02. Materials

Provide materials in accordance with the following sections:

Granular Material Class II AA 902
Open-Graded Aggregate 34R 902
End Sections 909
Pipe for Underdrains 909
Underdrain Outlets 909
Drainage Marker Posts 909
Sod 917
Topsoil 917
Mortar, Type R-2 1005

A. **Pipe.** Provide geotextile-wrapped perforated pipe and tubing for underdrains, except if using with open-graded backfill material. Provide non-perforated pipe and tubing not wrapped with geotextile for underdrain outlets. Provide the following slot or hole size and water inlet area for pipe if using steel furnace slag for open-graded drainage course.

Table 404-1:
Pipe Opening Sizes for Steel Furnace Slag Open-Graded Drainage Course

Opening Type	Size
Slot width	$^{1}/_{16}$ – ⅛ inch
Hole diameter	⅛ – $^{3}/_{16}$ inch
Water inlet area (min)	2 in²/ft of tubing

B. **Aggregate for Trench Backfill.** Provide open-graded aggregate 34R to backfill the trench for open-graded underdrain. Provide granular material Class II AA as backfill for other underdrains and underdrain outlets.

C. **Outlet Endings.** Provide a concrete ring, steel end section, or concrete end section for the outlet ending.

404.03. Construction

The plans will show the locations for underdrain and underdrain outlets or will establish a miscellaneous quantity of pipe for use on the project. The plans will show, or the Engineer will determine, the line and grade of the

underdrain. Place the outlets at the intervals shown on the plans and ensure that the outlets drain.

A. **Trench Excavation.** Excavate underdrain trenches using a wheel or chain trencher or other trenching method approved by the Engineer. Grade trench bottoms to the shape of the underdrain pipe. Line trenches for open-graded underdrains with geotextile blanket as required.

B. **Laying Underdrains.** Place the underdrains to the line and grade shown on the plans or established by the Engineer. Ensure a firm bearing along the length of the pipe. Place compatible end caps on the upgrade ends of the underdrain pipes. Remove and re-lay damaged or displaced pipe.

C. **Connections.** Select fittings and connection methods in accordance with the underdrain system manufacturer's recommendations to prevent pipe separation.

   Do not penetrate the inside diameter of the pipe with the self-tapping screws by more than ⅛ inch. Wrap fittings with geotextile blanket and seal the geotextile to the outlet pipe with waterproof tape.

D. **Backfill and Compaction.** Place backfill in trenches after the Engineer approves the underdrain line and grade.

   1. **Foundation, Bank, Subbase and Subgrade Underdrains, and Underdrain Outlets.** Backfill using granular material Class IIAA.

      Place the granular material around the pipe to cover the drain with at least 12 inches of material. Place the remaining backfill in layers no greater than 12 inches. Compact the trench backfill material within the influence of the roadbed to 95% of the maximum unit weight. Compact trenches outside the roadbed as directed by the Engineer.

      If the contract calls for open-graded subgrade underdrain and open-graded bank underdrain, place the open-graded aggregate 34R as shown on the plans for open-graded underdrains.

   2. **Open-Graded Underdrains.** Backfill pipe with open-graded aggregate 34R. After placing the backfill, compact the backfill and the surrounding grade material with a vibrating plate compactor. Begin compaction along the shoulder side of the underdrain and progress toward the pavement. Do not operate the compactor directly above the underdrain.

      Maintain the exposed underdrain and backfill to prevent contamination.

      Remove and replace contaminated backfill material as determined by the Engineer at no additional cost to the Department. Clear obstructed

underdrain as determined by the Engineer at no additional cost to the Department.

E. **Underdrain Outlet.** Lay underdrain outlets on at least a 4% grade and install the underdrain outlet at least 4 inches above the receiving ditch or sewer flow line. The Engineer may waive the percent grade requirement if determining that it is not practical to meet both the percent grade and the outlet elevation requirements. Connect underdrain outlet pipe to the underdrain in accordance with *MDOT Standard Plan R-80 series*. The use of wyes, tees, or other similar fittings is not acceptable. Do not backfill the outlet trench until approved by the Engineer. Install underdrain outlets within 48 hours of installing adjoining longitudinal underdrains. Mark and maintain the outlets until final acceptance of the work.

F. **Outlet Endings.** Place the outlet endings as shown on the plans or as directed by the Engineer. Install drainage marker posts in accordance with subsection 401.03.F.

Mark the locations of outlet endings on the adjacent shoulder if installing underdrains in conjunction with constructing or resurfacing concrete or HMA shoulders. Mark locations with a ½-inch-deep, 4- by 6-inch depression. Place the long edge of the depression perpendicular to the edge of the shoulder. The Engineer may approve the following alternative methods of marking locations:

1. Stencil markers in concrete shoulders after texturing.
2. Form markers in HMA shoulders during finish rolling. Obtain the Engineer's approval of forming method prior to beginning work.

G. **Cleanout.** Ensure that installed underdrains and outlets are free of silt, debris, and other deleterious material at the time of final acceptance.

H. **Video Inspection of Underdrains.** The Department will perform video inspection of underdrains, underdrain outlets, and outlet endings after installation is complete.

The Department will perform video inspections of open-graded underdrains after the mainline pavement placement is complete but before shoulder paving.

Submit a log detailing the locations of the drain outlets installed on the project to the Engineer. In the drain outlet log, include locations of bank drain outlets, subgrade and subbase underdrain outlets, and open-graded underdrain outlets.

1. **Deficiencies.** Corrective action, including excavating and repairing or removing and replacing the underdrain or underdrain outlets, will be required if video inspection reveals any of the following deficiencies:

a. Crushed pipe;

b. Separated joints,

c. Plugged underdrain or underdrain outlet pipe;

d. Standing water greater than half the pipe diameter for greater than 25 feet; or

e. Other defects in materials or workmanship as determined by the Engineer.

2. **Corrective Action.** Obtain approval from the Engineer for the repair or removal and replacement method before beginning corrective action. Complete corrective action within 10 working days of video inspection completion or other date as approved by the Engineer.

   Complete the following corrective action at no additional cost to the Department:

   a. Excavate;

   b. Repair or remove and replace defective underdrain, underdrain outlets, and outlet endings;

   c. Backfill excavated areas;

   d. Replace and compact overlying fill, aggregate base separator course, and open-graded drainage course materials;

   e. Replace geotextile separator as required; and

   f. Replace finished shoulder or pavement material in accordance with the contract.

404.04. Measurement and Payment

Pay Item	Pay Unit
Underdrain, Subgrade, __ inch	Foot
Underdrain, Bank, __ inch	Foot
Underdrain, Subgrade, Open-Graded, __ inch	Foot
Underdrain, Bank, Open-Graded, __ inch	Foot
Underdrain, Fdn, __ inch	Foot
Underdrain, Subbase, __ inch	Foot
Underdrain, Pipe, Open-Graded, __ inch	Foot
Underdrain, Edge of Pavt, __ inch	Foot
Underdrain Outlet, __ inch	Foot
Underdrain, Outlet Ending, __ inch	Each

A. **General.** The Engineer will measure underdrains in place.

The Engineer will measure **Underdrain Outlet**, of the size required, in place from the underdrain to the center of a drainage structure or from the underdrain to the end of the outlet pipe. In addition to work specified for individual pay items, the unit prices for the relevant underdrain and underdrain outlet pay items include the cost of the following:

1. Excavating the trench;
2. Providing and placing the pipe and fittings;
3. Providing, placing, and compacting the backfill material; and
4. Disposing of surplus material excavated from the trench.

The Department will not consider claims for additional compensation for time required to repair or remove and replace deficient underdrain, underdrain outlets, and overlying materials.

B. **Subgrade, Bank, Foundation, and Subbase Underdrains**. The unit prices for **Underdrain, Subgrade**; **Underdrain, Bank**; **Underdrain, Fdn**; and **Underdrain, Subbase** of the sizes required include the cost of providing the pipe and fittings with a geotextile wrap.

C. **Underdrain, Pipe, Open-Graded.** The unit price for **Underdrain, Pipe, Open-Graded** of the size required includes the cost of providing and lining the trench with geotextile blanket.

D. **Underdrain Outlet.** The unit price for **Underdrain, Outlet** of the size required includes the cost of the following:

1. Locating installed outlets;
2. Maintaining the end of the outlet pipe or end section clear of obstructions; and
3. Providing and installing temporary tie-downs.

E. **Underdrain, Outlet Ending.** The unit price for **Underdrain, Outlet Ending** of the size required includes the cost of the following:

1. Excavating the area at the end of the outlet;
2. Providing and placing the concrete ring, steel end section, or concrete end section; and
3. Disposing of surplus excavated material.

The Engineer will measure and the Department will pay for pipe or tubing used in or through the outlet ending as **Underdrain Outlet**. The unit price

for **Underdrain, Outlet Ending** includes the cost of marking the outlet ending locations on the adjacent shoulder.

The Engineer will measure and the Department will pay for drainage marker posts in accordance with subsection 401.04.

Section 501. Plant-Produced Hot Mix Asphalt

501.01. Description

This work consists of providing and placing hot mix asphalt (HMA) mix using Superpave mixture design methods.

A. Definitions

Binder Content. Percent by weight of asphalt cement in the total mixture.

Broken Aggregate. Cracked aggregate caused by construction operations.

Bulk Specific Gravity of Aggregate (G_{sb}). Ratio of the oven dry weight in air of a unit volume of an aggregate at a stated temperature to the weight of an equal volume of water at a stated temperature.

Crack. Visible fissure of varying length and orientation in the HMA, partially or completely through at least one course.

Effective Specific Gravity (G_{se}). Ratio of the oven dry weight in air of a unit volume of an aggregate (excluding voids permeable to asphalt) at a stated temperature to the weight of an equal volume of water at a stated temperature.

Flushing. Shiny or reflective condition, tacky to the touch, appearing on the HMA surface when asphalt binder collects in the voids at high pavement temperatures.

HMA Mix Design. Selection and proportioning of aggregates, mineral filler, reclaimed asphalt pavement (RAP), and asphalt binder to meet the required mix design criteria.

HMA Segregation. Areas of HMA pavement exhibiting non-uniform distribution of coarse and fine aggregate particles, visually or otherwise identifiable.

Job Mix Formula (JMF). HMA mix for a specific project, including adjustments to optimize the field application.

Lot. A lot is made up of a discrete tonnage of one mixture. A lot typically has five sublots (see definition of “sublot”).

Maximum Specific Gravity of Mixture (G_{mm}). Ratio of the weight in air of a unit volume of an uncompacted HMA at a stated temperature to the weight of an equal volume of water at a stated temperature.

Pavement. Completed HMA placement, including layers on driving lanes and shoulders.

Pavement Edge. Extremity boundaries of the pavement.

Roller Cracking. High-density surface map-cracking that appears immediately after rolling.

Rutting. Depression or displacement of the HMA surface that occurs in a longitudinal direction or a localized area.

Quality Assurance (QA). All activities dealing with acceptance of the product, including but not limited to materials sampling, testing, construction inspection, and review of Contractor quality control (QC) documentation. The Engineer's HMA QA procedures are contained in MDOT's *HMA Production Manual* and MDOT's *HMA QA Plan*.

Quality Control (QC). All activities dealing with process control to ensure quality, including but not limited to training, materials sampling, testing, project oversight, and documentation. For example, the Contractor's HMA QC procedures are contained in the Contractor's *HMA QC Plan*.

Sublot. Portion of a lot or an individual sample that is represented by a complete set of QA tests. Sublots are approximately equal in size at 1,000 tons. The Contractor and the Engineer may agree to reduce the typical 1,000-ton sublots based on project staging or other project conditions.

Target Value. JMF parameter value that may be adjusted, if approved by the Engineer, to account for changes in the physical properties of the mixture.

Temporary Pavement. Roadway and appurtenances constructed to help the movement of highway and pedestrian traffic around a construction operation that will be removed upon completion of the project.

Unlimited Daily HMA Production. Unrestricted daily HMA production tonnage.

Voids in Mineral Aggregate (VMA). Volume of void space between the aggregate particles of a compacted paving mixture that includes the air voids and the asphalt binder not absorbed into the aggregate, expressed as a percentage of the total volume of mixture.

501.02. Materials

Provide materials in accordance with the following sections:

Superpave HMA Mixtures 902
Superpave Aggregates 902
Mineral Filler, 3MF 902
Anti-Foaming Agent 904
Asphalt Binders 904
Bond Coat, SS-1h, CSS-1h, LTBC-1, LTBC-2 904

Plant-produced HMA consists of asphalt binder, aggregates, mineral filler, and other additives.

Provide release agents that do not harm the HMA mixture. Do not use fuel oil or other distillate derivatives.

Provide the HMA mix type and the performance grade of asphalt binder as required by the contract.

Provide blended aggregates for HMA top course mixtures, except top courses for shoulders, bike paths, temporary roads, and parking areas, meeting the required Aggregate Wear Index (AWI).

A. Composition of HMA Mixtures

1. **Mix Design.** Develop an HMA mix design in accordance with the *HMA Production Manual* and submit to the Department. The Department will evaluate the design in accordance with Section 1 of the *HMA Production Manual*, “Procedures for HMA Mix Design Processing.”

   Provide written certification that the materials in the mix design are from the same source and meet the material properties in the mix design or the Department-approved JMF. Make all JMF adjustments in accordance with the *HMA Production Manual*.

   Provide combined aggregate blends meeting the properties specified in section 902. Provide a mix design that meets the requirements in Table 501-1, Table 501-2, and Table 501-3.

   For mix design purposes, top and leveling courses are the mix layers within 4 inches of the surface. The base course consists of the layers below 4 inches from the surface. For mix layers within the 4-inch threshold, if less than 25% of the mix layer is within 4 inches of the surface, the mix layer is a base course.

Table 501-1: Superpave Mix Design Criteria

Design Parameter	Mix Number			
	5	4	3	2
Percent of maximum specific gravity (%G_{mm}) at the design number of gyrations (N_d)	96.0%(a)			
%G_{mm} at the initial number of gyrations (N_i)	See Table 501-3			
%G_{mm} at the maximum number of gyrations (N_m)	≤98.0%			
Voids in mineral aggregate (VMA) min % at N_d (based on aggregate bulk specific gravity (G_{sb}))	15.00	14.00	13.00	12.00
Voids filled with asphalt (VFA) at N_d	See Table 501-2(b)			
Fines to effective asphalt binder ratio (P_{No200}/P_{be})	0.6–1.2			
Tensile strength ratio (TSR)	80% min			

(a) Unless noted otherwise on the plans, design all mixtures to 96.0% of maximum specific gravity (%G_{mm}) at the design number of gyrations (N_d). During field production, increase percent of maximum specific gravity (%G_{mm}) at the design number of gyrations (N_d) to 97.0%. Use liquid asphalt cement for regression of mixes unless otherwise noted on plans.

(b) For regressed mixtures the maximum criteria limits do not apply.

Table 501-2:
VFA Minimum and Maximum Criteria

Estimated Traffic (million ESAL)	Mix Type	Top and Leveling Courses	Base Course
≤0.3	EL	70–80%	70–80%
>0.3 – ≤3.0	EML	65–78%	65–78%
>3.0 – ≤30	EMH	65–78%(a)	65–75%
>30 – ≤100	EH	65–78%(a)	65–75%

ESAL = equivalent single-axle load

(a) The specified VFA range for mix Number 5 is 73–76%.

Table 501-3:
Superpave Gyratory Compactor Compaction Criteria

Estimated Traffic (million ESAL)	Mix Type	%G_{mm} at (N_i)	Number of Gyrations(a)		
			N_i	N_d	N_m
≤0.3	EL	≤91.5%	7	50	75
>0.3 – ≤3.0	EML	≤90.5%	7	75	115
>3.0 – ≤30	EMH	≤89.0%	8	100	160
>30 – ≤100	EH	≤89.0%	9	125	205

ESAL = equivalent single-axle load

(a) Compact mix specimens fabricated in the Superpave gyratory compactor (SGC) to N_d. Use height data provided by the SGC to calculate volumetric properties at N_i. Compact mix specimens at optimum P_b (percent asphalt binder content) to verify N_m for mix design specimens only.

If high-stress HMA is shown on the plans, provide the same mix designation (5EML, 5EMH, 4EML, 4EMH, etc.) as required for the

mainline top and leveling courses, except change the performance-graded (PG) binder as shown on the HMA application table.

2. **Recycled Mixtures**. Recycled asphalt pavement (RAP) may be substituted for a portion of the new material required to produce the HMA mixture. Design and produce the mix to meet the criteria in this subsection and the contract.

   a. **Stockpile Requirements.** Process RAP to the size required for the specified HMA mix. Ensure the stockpile contains enough material to produce the recycled mixtures the Engineer approves for the project. If the RAP stockpile is not sufficient to produce recycled mix quantities required for the project, provide an Engineer-approved mix design without RAP at the same unit price.

      Provide documentation of testing (one test per 1000 tons, minimum of three tests) and accumulated tonnage in the stockpile to the MDOT laboratory. The tonnage may be estimated. The Department will begin evaluating the mix design after receipt of the documentation.

   b. **Mix Design.** Submit required documentation for recycled mix designs in accordance with Section 1 of the *HMA Production Manual*, “Procedures for HMA Mix Design Processing.”

B. **HMA Plant Certification.** Ensure HMA plants are certified by the Department at least 5 days before mix production begins. The Engineer will certify HMA facilities in accordance with Section 2 of MDOT’s *HMA Production Manual*, “Certification Procedure of HMA Plants.” Post a seal of certification in the plant control office.

C. **HMA Production.** Submit an approved mix design for the mix required to the Engineer at least 4 days before production begins.

   Provide even heating of the mass of asphalt binders and maintain heat control. Heat asphalt binders to the temperature required for the type of binder. Do not exceed the maximum temperature specified in Table 904-8 for asphalt binder and HMA. The Department will reject asphalt binder and mix if the temperature exceeds the maximum specified in Table 904-8. The Department will reject contaminated asphalt binder.

   Stockpile aggregates at the facility in a manner that prevents segregation. Dry aggregates to a moisture content that will ensure an appropriately coated HMA mix. For batch and continuous plants, the Department will reject aggregates in the hot bins that contain sufficient moisture to cause foaming or a water-saturated mixture. Remove rejected materials from the bins.

Place uniform gradations of aggregates in the cold feed system. If providing a blend of aggregates for the mix by combining aggregates from at least two cold feed bins, ensure that the blend meets the combined gradation (from JMF) QC tolerances.

The use of at least one hot aggregate bin to proportion aggregates to meet the JMF tolerances is allowed if the cold feed requirements are met.

501.03. Construction

A. **Equipment.** Provide equipment in accordance with section 107, capable of producing pavement that meets the requirements of this section.

1. **Cold-Milling Machines.** Provide equipment that consistently removes the HMA surface, in one or more passes, to the required grade and cross section, and produces a uniformly textured surface. Provide machines equipped with the following:

   a. Provide a cold-milling machine that has sufficient power, traction, and stability to maintain an accurate depth of cut. Maintain the propulsion and guidance system of the milling machine in such condition that the milling machine may be operated to straight and true lines;

   b. Provide a cold-milling machine capable of operating using minimum 30-foot automatic grade controls (contact or non-contact) averaging system or other approved grade control systems and capable of transverse slope control. Describe the use of such controls in the Contractor's *Cold-Milling Quality Control Pla*n; and

   c. Provide a cold-milling machine capable of picking up the removed material in a single operation. A self-loading conveyor will be an integral part of the milling machine. Windrows are not allowed.

2. **Hauling Equipment**. Ensure that transport trucks are equipped to protect the mix from the weather and retard the loss of heat. Equip transport trucks and trailers with a working backup alarm.

3. **Pressure Distributor**. Provide a pressure distributor in accordance with subsection 505.03.A.1.

4. **Pavers.** Equip each paver with a full-width vibratory or tamper bar screed capable of spreading and finishing HMA to the required cross section and grade. Use a paver that produces a uniformly finished surface, free of tears, other blemishes, and measurable segregation.

   Equip the paver to provide a uniform head of material ahead of the screed. Install reverse pitch augers or paddles inside the ends of the auger shafts to force the mix to the center of the main screed.

Ensure that extensions added to the main screed provide the same vibrating or tamping action and heating capabilities as the main screed. Adjust extensions to the main screed so, after breakdown rolling, no longitudinal marks remain on the surface. Equip in-line screed extensions with a continuation of the automatically controlled spreading augers to within 12 inches of the outside edge. Follow the manufacturer's recommendations for other screed extensions.

Except for the paving operations listed in subsection 501.03.F.1.a through subsection 501.03.F.1.d, equip pavers with an automatically controlled and activated screed with grade reference and transverse slope control. Use an Engineer-approved grade referencing attachment, at least 30 feet long for lower courses and the first pass of the top course. Ensure that the Engineer approves alternate grade referencing attachments before use.

After placing the first pass of the top course, the Contractor may, with prior approval from the Engineer, substitute a joint matcher, a grade referencing attachment at least 10 feet long, or other grade referencing equipment for constructing adjacent passes of the top course.

5. **Rollers**

   a. **Steel-Wheeled Rollers.** Provide self-propelled vibratory steel-wheeled rollers, static tandem rollers, or self-propelled static three-wheeled rollers. Provide a steering device that allows the roller to follow the established alignment. Equip rollers with wheel sprinklers and scrapers. Provide smooth roller wheels, free of openings or projections that will mar the pavement surface.

      Provide vibratory rollers with an automatic shutoff to deactivate the vibrators if the roller speed decreases below ½ mph. Provide rollers that operate in accordance with the manufacturer's recommended speed, impacts per foot, and vibration amplitude for the thickness of HMA mix.

   b. **Pneumatic-Tired Rollers.** Provide self-propelled pneumatic-tired rollers. Equip rollers with at least seven wheels spaced on two axles so the rear group of tires does not follow in the tracks of the forward group, providing at least ½-inch tire path overlap. Provide smooth tires capable of being inflated to the pressure recommended by the roller or tire manufacturer. Equip the rollers

with a mechanism that can smoothly reverse the motion of the roller.

Equip the rollers with wheel scrapers and skirting to enclose the wheels to within 3 inches of the pavement surface. Use a release agent to prevent material from sticking to the tires and being deposited on the top course pavement during rolling.

c. **Combination Rollers.** The Contractor may use combination pneumatic-tired and steel-wheeled rollers manufactured specifically for HMA compaction, if equipped with the required sprinklers and scrapers.

6. **Spreaders.** Use self-propelled spreaders capable of pushing the hauling units. Ensure that spreaders can maintain the required width, depth, and slope, without causing segregation.

7. **Material Transfer Device.** When a material transfer device (MTD) is required, it must be capable of delivering HMA mix from the truck transport to the paver hopper to ensure constant paver speed, remixing HMA material using manufacturer's developed technology, and depositing material in the paver hopper. Provide a paver hopper insert with at least a 10-ton capacity in the paver and keep at least two-thirds full of mix during paving. A windrow pickup machine does not satisfy the requirements for an MTD.

8. **Compressed Air System**. If a compressed air system is required for cleaning pavement, equip the air compressor with a moisture separator to remove oil and water from the air supply. Provide a compressor capable of producing at least 100 psi and continuous 150 cfm airflow.

9. **Miscellaneous Equipment**. Provide a straightedge, at least 10 feet long, and other tools to finish the work.

10. **Lights on Equipment**. If maintaining traffic on HMA construction, equip equipment within the project, including cold-milling machines, distributors, and rollers, with at least one Department-approved flashing, rotating, or oscillating amber light. Equip pavers with at least one light on each side. Mount the lights so the warning signal is visible to traffic in every direction. Operate the lights while work is in progress. Ensure that hauling units activate four-way flashers on the project.

B. **Preparation of Base.** Provide subgrade, subbase, aggregate base course, crushed and shaped base, or rubblized base in accordance with the relevant sections of Division 2 and Division 3, before HMA placement.

C. **Preparation of Existing Pavement.** Prepare the existing surface as required to construct HMA pavements, shoulders, and approaches.

1. **Drainage Structures, Monument Boxes, and Water Shutoffs.** Adjust, temporarily lower, or both, catch basins, manhole covers, monument boxes, and water shutoffs in accordance with subsection 403.03.A. Meet the smoothness requirements required in subsection 501.03.H.

2. **Cleaning Pavement.** Using methods approved by the Engineer, clean dirt and debris from the pavement surface and paved shoulders before placing HMA. Remove loose material from joints and cracks using compressed air.

   If the Engineer determines the compressed air system will not remove deleterious material, remove loose material by a hand or mechanical method, as approved by the Engineer. The Department will pay for removal of material by hand or mechanical methods in accordance with subsection 501.04.E.

   Do not place HMA until the Engineer inspects and approves the condition of the existing pavement.

3. **Removing Existing Pavement for Butt Joints**. If a butt joint is required, remove the existing surface to the thickness of the proposed overlay for the full width of the joint. Uniformly taper the removal to the original surface over at least 35 feet.

4. **Edge Trimming.** For required removal of HMA shoulder material or no greater than 1 foot width of HMA pavement, cut the HMA material full depth along the pavement edge or removal line to prevent tearing the pavement surface. Cut joints, where the completed surface will be exposed, with a saw, cold-milling machine, or other methods approved by the Engineer. Cut joints, where the completed surface will be covered by HMA mix, with a coulter wheel, saw, cold-milling machine, or other method approved by the Engineer.

5. **Cold-Milling HMA Surfaces.** Before milling existing pavement, obtain a Department-approved mix design in accordance with subsection 501.02.A, and ensure the availability of HMA mix quantities to cover milled surfaces. Do not maintain traffic on the milled surface unless specified in the contract or approved by the Engineer.

   Cold-Milling QC Plan and Cold-Milling Operations Plan. Prior to beginning milling operations, submit a *Cold-Milling QC Plan* and a *Cold-Milling Operations Plan* to the Engineer for approval.

a. Include, as a minimum, the following items in the *Cold-Milling QC Plan*:

   i. The schedule for replacing the cutting teeth;

   ii. The daily preventive maintenance schedule and checklist;

   iii. Proposed use of automatic grade controls;

   iv. The surface testing schedule for smoothness;

   v. The process for filling distressed areas;

   vi. The schedule for testing macrotexture of the milled surface;

   vii. Corrective procedures if the milled surface does not meet the minimum macrotexture specification;

   viii. Corrective procedures if the milled surface does not meet the minimum transverse or longitudinal surface finish when measured with a 10-foot straightedge;

   ix. The methods for longitudinal control guidance (painted string line or measure offs); and

   x. Contact information for on-site contractor personnel responsible for the work and authorized to adjust the QC plan.

b. Include, as a minimum, the following specific items in the *Cold-Milling Operations Plan*:

   i. Number, types, and sizes of mill machines to be used;

   ii. Width and location of each mill machine pass;

   iii. Number and types of brooms and or vacuum trucks to be used and their locations with respect to the mill machine;

   iv. Proposed method for mill machine and wedging around existing structures such as manholes, valve boxes, and inlets;

   v. Longitudinal and transverse typical sections for tie-ins at the end of the day;

   vi. If requested by the Engineer, a plan sheet showing the milling passes; and

   vii. Names of macro-texture testing personnel and sequencing of testing (minimum of three tests daily that are representative of the day's milling).

   Remove the HMA surface to the depth, width, grade, and cross section shown on the plans. Backfill and compact depressions

resulting from removal of material below the specified grade, in accordance with subsection 501.03.C.9.

If the milling machine discovers buried structures within the specified grade, such as valve boxes, manholes, or railroad tracks that are not identified on the plans, the Department will pay for all associated costs, as extra work, in accordance with subsection 103.02.

Immediately after cold-milling, clean the surface. Dispose of removed material in accordance with subsection 104.07.D and subsection 204.03.

Mill the existing pavement to the cross slope shown on the plans. Supply a 10-foot straightedge. Ensure that the finished surface does not vary longitudinally or transversely more than ¼ inch from a 10-foot straightedge. Ensure that the milled area is free from gouges, continuous grooves, and ridges and has a uniform texture. Ensure that the horizontal gouge in the vertical edge created from the milling operation is limited to a maximum width of 1.0 inch. Adjust speed, drum speed, and/or teeth as necessary to meet the requirements of this specification. Ensure that the milling operation provides an acceptable surface texture by achieving a maximum mean texture depth of 0.108-inch thickness according to ASTM E965. Perform three random QA macro texture tests daily that are representative of the day's milling to maintain texture and verify conformance with the 0.108-inch thickness mean texture depth requirement. For projects with less than 3,000 square yards, a minimum of one random QA macro texture test per day is required. Perform tests as soon as practical behind the milling operations.

6. **Removing HMA Surface.** Except as specified in subsection 501.03.C.4, removing an HMA surface applies to removing HMA overlying a material designated for removal or that is required to remain in place.

   Cut joints, exposed in the completed surface, with a saw or cold-milling machine. Cut joints, covered by HMA mix, with a coulter wheel, saw, or cold-milling machine. Obtain the Engineer's approval of alternate methods for cutting joints.

   When removing HMA overlying a base course that is to remain in place, cut the edges of the surface requiring removal along straight lines for the full depth of the HMA surface.

When removing HMA by cold-milling, the Engineer may direct removal to be less than the full depth of HMA surface.

7. **Removing HMA Patches**. Remove patches that may compromise the performance of the overlay.

8. **Joint and Crack Cleanout**. If the plans show joint and crack cleanout, use mechanical or hand methods to remove joint sealants to at least 1 inch deep. Remove vegetation, dirt, and debris that cannot be removed using the methods specified in subsection 501.03.C.2 from transverse and longitudinal joints and cracks. Use hand patching to fill cleaned joints and cracks at least 1 inch wide.

9. **Hand Patching**. If the contract requires hand patching, fill holes, depressions, joints, and cracks in the existing pavement and replace existing patches. Compact the hand patching material in no greater than 3-inch layers to the adjacent pavement surface grade using a machine vibrator or Department-approved roller. Use top course or other Engineer-approved mix for hand patching material.

10. **Repairing Pavement Joints and Cracks**. Repair joints and cracks as required.

D. **Bond Coat.** Uniformly apply the bond coat and provide complete coverage to a clean, dry, surface with a pressure distributor. Obtain the approval of the Engineer for the application rate after work begins. Application rate must be within a range of 0.05 to 0.15 gallons per square yard. Apply the bond coat ahead of the paving operation to allow the bond coat to cure before placing HMA.

Do not leave pools of bond coat on the surface and do not spray the bond coat on adjacent pavement surfaces. Apply the bond coat to each HMA layer and to the vertical edge of the adjacent pavement before placing subsequent layers.

E. **Transportation of Mixtures.** Weigh each load of HMA, accepted by the Department, to the nearest 20 pounds on an approved scale with an automatic printout system. Provide a scale and printout system for platform and suspended scales in accordance with subsection 109.01.B.6. Provide a ticket to the Engineer with each load.

Apply a release agent, in accordance with subsection 501.02, to hauling units. Loads with excessive amounts of release agent will be rejected. Do not place crusted HMA in the paver.

The Department will reject loads, immediately prior to placement, with a temperature either below 250°F (225°F when using a warm mix chemical

additive) or greater than 20°F from the recommended maximum mixing temperature specified by the binder producer.

F. Placing HMA

1. General

Place HMA on a cured bond coat using pavers in accordance with subsection 501.03.A.4 unless placing mixtures for the following:

a. Variable width sections;

b. The first course of a base course mix on a subgrade or sand subbase;

c. Base course mixtures for shoulders and widening less than 10½ feet wide; or

d. Top and leveling course mixes for shoulders and widening less than 8 feet wide.

Place HMA mix in layers, and do not exceed the application rate. If the application rate for an HMA pavement exceeds the maximum rates specified in Table 501-4 and the edges are not confined, construct the pavement in at least two layers.

Table 501-4:
HMA Application Rates

Mix Number[(a)]	Course Application	Application Rate (lb/yd²), minimum – maximum[(b)]
2	Base	435–550
3	Base, leveling	330–410
4	Leveling, top	220–275
5	Top	165–220

(a) See Table 501-1 for the mix number design parameters.
(b) Minimum application rates do not apply to wedging courses.

Wedge with HMA to remove irregularities in the existing road surface. Place and compact HMA wedging to correct the foundation. Allow the wedging to cool enough to support construction equipment without causing visible distortion of the mat before placing subsequent wedging, base, leveling, or top course mixtures.

Place HMA mix to the slope and width shown on the plans. Place subsequent HMA course to align the vertical edge with the previous courses, without constructing a ledge. Correct ledges that result from placing material in excess of the width shown on the plans at no additional cost to the Department.

Place shoulder aggregate and compact flush after placement of each layer of HMA at the end of the paving day or place traffic control devices in accordance with subsection 812.03, at no additional cost to the Department. Complete final shaping and compaction of the shoulders after placing the top course of HMA.

If delays slow paving operations and the temperature of the mat immediately behind the screed falls below 200°F, stop paving and place a transverse construction joint. If the temperature of the mat falls below 190°F before initial breakdown rolling, remove and replace the mat at no additional cost to the Department.

If placing the uppermost leveling and top course, place the longitudinal joint to coincide with the planned painted lane lines.

If the temperature of the mat falls below 170°F before placing the adjacent mat, apply bond coat to the vertical edge of the mat.

If constructing the lanes with at least two pavers in echelon, match the depth of loose HMA from each paver at the longitudinal joints.

2. **Joints in HMA Pavement**

   a. **Transverse Construction Joint.** If constructing a transverse construction joint, stop the paver and lift the screed before material falls below the auger shaft. Remove the paver and roll through the planned joint location. Cut a transverse vertical joint and remove excess HMA.

      Place burlap, canvas, or paper as a bond breaker ahead of and against the vertical face. Place HMA against the bond breaker and taper from the new mat to the existing surface. Extend the temporary taper 5 feet for each inch of mat thickness, or as directed by the Engineer. Compact and cool the temporary taper before allowing traffic on the new surface. Remove the temporary taper before resuming paving.

   b. **Feather Joint**. Transition the new mat to existing surfaces at the beginning and end of resurfacing sections and at intersections unless using butt joints. Transition the new mat to existing surfaces at a rate of 1 inch over 35 feet. Construct transitions on a cured bond coat applied at a rate of 0.10 gallon per square yard. After compaction, spray with bond coat, sand, and roll the first 3 feet of the joint and 1 foot of the existing surface.

   c. **Vertical Longitudinal Joint.** When opening to traffic, plan the work to resurface adjacent lanes to within one load of the same

ending point at the completion of paving operations each day. Construct a vertical joint to conform to the pavement cross section.

When compacting an unsupported (unconfined) edge of the mat, keep the roller from 3 to 6 inches inside the unsupported edge on the first pass; ensure that the roller overhangs the unsupported edge by 3 to 6 inches on the second pass.

When placing HMA in a lane adjoining a previously placed lane, place the mixture so that the strike-off shoe will produce an edge that is adjacent to or minimally overlaps the adjoining course. Compact the longitudinal joint by rolling from the hot side, keeping the edge of the roller approximately 6 inches to 8 inches inside the cold joint for the first pass. For the second pass of the roller, compact the joint from the hot side while overlapping the cold side by 6 to 8 inches.

d. **Tapered Overlapping Longitudinal Joint.** A tapered overlapping longitudinal joint may be used instead of a longitudinal vertical joint.

If using tapered overlapping longitudinal joints, resurfacing lanes within one load of the same point-of-ending at the completion of paving operations each day is not required. Pave adjacent lanes within 24 hours unless delayed by inclement weather or approved by the Engineer.

Construct the tapered overlapping longitudinal joint by tapering the HMA mat at a slope no greater than 1:12. Extend the tapered portion beyond the normal lane width.

Place a ½-inch to 1-inch notch at the top of the taper on paving courses.

Provide a uniform slope by constructing the tapered portion of the mat using a Department-approved strike-off device that will not restrict the main screed.

Apply bond coat to the surface of the taper before placing the adjacent lane.

3. **Placing HMA Shoulders.** Use a self-propelled mechanical paver or spreader to place HMA shoulders.

If placing the top course on new shoulders, or placing leveling, or top course on existing HMA shoulders at least 8 feet wide, place the mix using a paver with an automatically controlled and activated screed and strike-off assembly and corresponding grade referencing

equipment. Use grade-referencing equipment as directed by the Engineer.

Stop shoulder paving at crossroad approaches, auxiliary lanes, commercial driveways, and ramps. Do not pave through these areas.

4. **Placing HMA Approaches.** Place HMA on driveway or crossroad approach foundations, as approved by the Engineer.

   Place approaches in layers no greater than the application rate. Do not stop mainline paving of lanes adjacent to the approach to pave the HMA approach.

5. **Safety Edge.** Construct the safety edge on the shoulders at locations shows on the plans. The finished shape of the safety edge will be in accordance with *MDOT Standard Plan R-110* series. Ensure that the safety edge is constructed monolithically with the shoulder and is of the same material type. Prior to placing HMA shoulder overlays, prepare the existing shoulder material to provide a smooth and uniform paving surface. Excavate, trench, and/or shape the existing shoulder material so that the safety edge may be placed as required on the plans. Ensure that the existing material does not impede the paving equipment and placement of HMA. For new or reconstructed shoulders, prepare base materials in accordance with the plans.

   Use an approved longitudinal safety edge system to create a sloped edge profile onto the roadway shoulder. Use an approved safety edge system that compacts the HMA and provides a finished sloped wedge in accordance with the contract. Do not use a single plate strike off. Use a system that is adjustable to accommodate varying pavement thicknesses.

   Prior to commencing any shoulder work, provide a test section to demonstrate the safety edge finished shape and compaction of the proposed safety edge system. The Engineer may waive the test section if satisfactory evidence is provided that the proposed system has been successfully used on other MDOT or MDOT local agency projects. Ensure that all safety edge systems have been approved by the Engineer.

G. **Rolling.** Compact each layer of HMA in accordance with the contract and free of roller marks.

   Keep the surface of the steel roller wheels moist during rolling.

   Use a pneumatic tire roller on HMA overlay projects in the intermediate rolling position to knead HMA over existing pavement.

H. **Smoothness Requirements.** After final rolling, the Engineer may test the surface longitudinally and transversely using a 10-foot straightedge at selected locations in accordance with Michigan Test Method (MTM) 722. Construct the surface and correct variations, at no additional cost to the Department, to the tolerances specified in this subsection.

1. **Base Course.** Construct lower layers of base courses to a tolerance of ¾ inch and final layers of base courses to a tolerance of ⅜ inch.

2. **Leveling and Top Course.** For multiple course construction, construct lower courses to a tolerance of ¼ inch and top courses to a tolerance of ⅛ inch.

3. **Single Course Overlays.** Construct single courses to a tolerance of ¼ inch.

4. **Longitudinal Joints.** Construct adjacent lanes to a tolerance of ¼ inch for base and leveling courses and a tolerance of ⅛ inch for top courses.

5. **Drainage Structures, Monument Boxes, and Water Shutoffs.** Construct to a tolerance of ¼ inch.

I. **Weather Limitations**

1. **HMA Weather Limitations.** Place HMA in accordance with the following restrictions:

a. Do not place HMA or apply bond coat when moisture on the existing surface prevents curing;

b. Do not place HMA unless the temperature of the surface being paved is at least 35°F and there is no frost on or in the grade or on the surface being paved, unless otherwise approved by the Engineer in writing;

c. Place only HMA courses that are greater than 200 pounds per square yard if the temperature of the surface being paved is greater than 35°F;

d. Place only HMA courses that are greater than 120 pounds per square yard if the temperature of the surface being paved is at least 40°F; and

e. Place any HMA course if the temperature of the surface being paved is at least 50°F.

J. **Protection of Structures.** Protect bridges, curbs, gutters, driveways, sidewalks, barriers, and other appurtenances to prevent surfaces from becoming discolored during application of bond coat or HMA to the road

surface. Remove material from appurtenances, as directed by the Engineer, at no additional cost to the Department.

K. **Aggregate Shoulders.** On resurfacing projects, scarify existing aggregate shoulder surfaces before placing new aggregate material.

Maintain the shoulder for vehicles to pass the construction equipment. If Contractor operations or traffic disturbs the area between the pavement and the right-of-way line, restore the area to a condition approved by the Engineer at no additional cost to the Department.

L. **Monument Boxes.** Place or adjust monument boxes in accordance with section 821.

M. **Quality Control Plan.** Prepare and implement a QC plan for HMA in accordance with MDOT's *HMA Production Manual*.

Make adjustments in process controls to prevent production of non-conforming material instead of accepting payment at a reduced price. The Department will not allow continual production of non-conforming material at a reduced price instead of making adjustments.

The Engineer will not perform sampling or testing for QC or assist in controlling the HMA production and placement operations.

N. **HMA Mix Acceptance.** The Engineer will inspect field-placed material, perform QA sampling and testing, and monitor Contractor adherence to the Contractor's *HMA QC Plan*.

1. **HMA Field-Placed Inspection.** The Engineer will perform a visual inspection of HMA to identify areas requiring corrective action. The Engineer will inspect the base and leveling courses within 18 hours and the top course within 36 hours of placement. If the Engineer determines that corrective action is required, do not pave overlying courses until after corrective action is completed and the Engineer determines that the pavement is in conformance with the contract.

   The Engineer will determine the need for corrective action based on the factors specified in Table 501-5. Corrective action may include remedial treatment, including crack or surface sealing, or replacement.

   Submit an action plan to the Engineer that addresses all factors that resulted in the need for corrective action. Complete all corrective action required to repair or replace unacceptable work at no additional cost to the Department.

   If the Engineer and the Contractor agree, the Department may make a contract adjustment of no greater than 100% of the bid price for corrective action.

Table 501-5:
HMA Criteria for Corrective Action

Criterion[a]	Length	Extent[b]	Severity	Corrective Action[c]
Segregation	—	>215 ft²/ 328-foot LL	Heavy[d]	Replace
Rutting	—	>32 feet	>¼ inch average depth over the length of occurrence	Replace
Flushing	—	>108 ft²/ 328-foot LL	High[e]	Replace
Edge of paved shoulder	>33 feet	Visible ledges	>3 inches	Trim
Crack[g]	Any	Any	All	Seal[f]

LL = lane length

(a) Criteria apply to all courses except flushing, which applies to the top course only.

(b) Extent is calculated by summing locations within the required length.

(c) The appropriate corrective action depends on the extent and severity of the criteria and on the intended service life of the pavement.

(d) Segregation severity will be determined in accordance with MTM 326. If segregation thresholds are met twice on a paving course, the use of an MTD for the remaining paving for that course may be required at no additional cost to the Department.

(e) Flushing severe enough to significantly affect surface friction (Friction Number <35).

(f) Other corrective action may be required as crack frequency increases.

(g) A reflective crack determined by the Engineer to be caused by an underlying condition does not require corrective action.

The Department will not grant extensions of time for repair work to meet the inspection acceptance requirements specified in subsection 501.03.N.1.

The Engineer will determine the area subject to corrective action, for removal and replacement of top courses, as the longitudinal extent of corrective action multiplied by the width of the paving course affected.

The Department will accept HMA subject to corrective action as follows:

a. HMA placed for corrective action involving full removal and replacement will be accepted in accordance with the contract.

b. The area requiring corrective action other than full removal and replacement will not be measured for incentive payment.

c. If more than 10% of the area of a sublot requires corrective action, the sublot will not be measured for incentive payment.

2. **HMA Testing Acceptance**. The Engineer will accept HMA based on visual inspection, small tonnage, or QA sampling and testing

acceptance criteria The Engineer will notify the Contractor before conducting QA sampling to allow the Contractor to witness the sampling, but not in a manner that will allow alteration of production in anticipation of sampling. The Engineer will conduct QA sampling in accordance with MTM 313 or MTM 324.

a. **Visual Inspection Acceptance Criteria**. The Engineer may accept quantities less than 500 tons, of any individual mixture, in accordance with MDOT's *Materials Quality Assurance Procedures (MQAP) Manual*.

b. **Temporary Pavement Acceptance Criteria.** The basis for measuring the mixture quality is QC testing and the QC processes specified in the applicable contract specifications for Superpave or Marshall mixes. Provide a copy of QC result to the Department within 24 hours upon request. The Department is not required to perform QA testing for the temporary HMA but reserves the right to perform verification testing. All materials and HMA mixture requirements apply. The initial production lots will be waived upon request. There are no pay factor or price adjustments based on mixture volumetrics for the temporary HMA.

   Perform all maintenance with the exception of snow and ice removal during the seasonal shutdown period. Maintain temporary pavement until the completion of the contract or the opening to traffic of the new pavement.

   Correct all deficiencies with the temporary pavement. The Engineer will make a negative adjustment for deficiencies requiring repairs or renewals, not corrected within the time frames stated in section 812 and for each occurrence that maintenance is required on the temporary HMA. Contract price adjustments will be made, according to Table 501-6, for each occurrence that repairs or renewals are required on the temporary roadway that are not attributable to normal wear and tear of traffic, weather, or an inadequate base condition not addressed in the contract.

O. **Asphalt Binder Acceptance.** The Department will accept asphalt binder in accordance with Department procedures.

Table 501-6:
Contract Adjustments for Maintenance of Temporary Pavement

ADT[a]	Per Maintenance Occurrence
0–10,000	$2,000[b]
10,000–40,000	$4,000[b]
≥40,000	$8,000[b]

(a) Based on average daily traffic (ADT) shown on Title Sheet

(b) The contract adjustment will be doubled if the Contractor 's *HMA-QC Plan* is not adhered to.

501.04. Measurement and Payment

Pay Item	Pay Unit
HMA, 5 E __	Ton
HMA, 4 E __	Ton
HMA, 3 E __	Ton
HMA, 2 E __	Ton
HMA, (type), High Stress	Ton
HMA Approach	Ton
HMA Approach, High Stress	Ton
HMA, Temp Pavt (mix type)	Ton
Pavt for Butt Joints, Rem	Square Yard
Edge Trimming	Foot
Cold Milling HMA Surface	Square Yard, Ton
HMA Surface, Rem	Square Yard
HMA Patch, Rem	Square Yard
Joint and Crack, Cleanout	Foot
Hand Patching	Ton
Pavt, Cleaning	Lump Sum
Pavt Joint and Crack Repr, Det __	Foot

A. **HMA, (type), High Stress.** The Department may pay for HMA, (type), High Stress for up to 150 feet outside the limits shown on the plans to allow time to transition to the high-stress HMA. The Department will pay for high-stress HMA placed outside the 150-foot limit as other HMA mix pay items.

B. **Pavement for Butt Joints, Removal.** The unit price for **Pavt for Butt Joints, Rem** includes the cost of removing and disposing of concrete or HMA materials.

C. **Edge Trimming.** The Engineer will measure **Edge Trimming** along the cut edge. The unit price for **Edge Trimming** includes the cost of cutting, removing, and disposing of excess HMA material.

D. **Cold Milling HMA Surface.** The unit price for **Cold Milling HMA Surface** includes the cost of removing, loading, hauling, weighing, and disposing of the cold-milled material, and cleaning the cold-milled pavement. If paid by the ton for cold-milled HMA, deposit the cold-milled material directly from the cold milling machine into the hauling units and weigh on a scale meeting the requirements of subsection 109.01.B before placement in a stockpile or a disposal area.

Material picked up by cleaning after cold milling is not weighed or paid for.

Macrotexture testing, macrotexture corrective actions, cleaning, and all other work related to mean texture depth requirements will not be measured and paid for separately but must be included in the work.

Separate payment will not be made for providing and maintaining an effective *Cold-Milling QC Plan*, nor for providing and maintaining an effective *Cold-Milling Operations Plan*.

E. **Pavement, Cleaning.** The Engineer will measure **Pavt, Cleaning** as a unit, including paved shoulders, approaches, and widened areas. The unit price for **Pavt, Cleaning** includes the cost of cleaning the foundation, joints, and cracks, and sweeping shoulders, base courses, and leveling courses.

If the Engineer directs additional hand or mechanical methods to clean the pavement, the Department will pay for this work as **Joint and Crack, Cleanout** if the contract includes the pay item. If the contract does not include a pay item for joint and crack cleanout, the Department will pay for additional hand or mechanical work as extra work, in accordance with subsection 109.05.

F. **Joint and Crack, Cleanout.** The Engineer will measure **Joint and Crack, Cleanout** along the cleaned joint and crack.

G. **Hand Patching.** The unit price for **Hand Patching** includes the cost of placing HMA, by hand or other methods, and compacting the material.

H. **Removing HMA Surface.** The Engineer will measure, and the Department will pay for removing HMA surface, no greater than 12 inches thick, overlying a material designated for removal or that is required to remain in place, as **HMA Surface, Rem**. The unit price for **HMA Surface, Rem** includes the cost of edge cutting to establish a neat line, as required, and removal and disposal of the HMA material.

For removal of HMA surfaces from structures, the unit price for **HMA Surface, Rem** includes the cost of removing old membrane.

The Engineer will measure, and the Department will pay for removing HMA surface, greater than 12 inches thick, overlying a material designated for removal or that is required to remain in place, as **Pavt, Rem** in accordance with subsection 204.04.

I. **Pavement Joint and Crack Repair.** The Engineer will measure **Pavt Joint and Crack Repr**, of the detail required, along the joint and crack. If the pavement joint and crack repair exceeds 30 inches in width, the Engineer will measure each 30-inch wide segment, or portion thereof, separately for payment. The Department will pay for the HMA material used to fill the joints after removal of objectionable material, as **Hand Patching**.

J. **Safety Edge.** Separate payment will not be made for constructing a safety edge. All costs associated with providing a safety edge, including base preparation and additional equipment or modification to existing equipment, will be included in the applicable unit prices for the related HMA mixtures.

K. **HMA.** The Engineer will measure, and the Department will pay for, **HMA** and **HMA, Temp Pavt (mix type)** of the mix specified based on the weight placed, as supported by weigh tickets. The Engineer will adjust the unit price for HMA of the mix specified, in accordance with the contract.

Section 602. Concrete Pavement Construction

602.01. Description

This work consists of constructing a jointed portland cement concrete pavement, unbonded concrete overlay, base course, or shoulder, with or without reinforcement. This work also includes submitting a concrete quality control (QC) plan in accordance with section 1002 before beginning concrete production.

A. **Definitions.** The term “pavement,” as used in these specifications, may include the following:

Concrete Base Course. Concrete pavement that will be surfaced with hot mix asphalt (HMA) or concrete overlay.

Concrete Overlay. Concrete pavement placed on an existing pavement section. Typical sections consist of standard widths and of lengths that are conducive to production paving.

Concrete Pavement. Concrete placed for mainline pavement, multiple-lane ramps, and collector-distributor roadways. Typical sections consist of standard widths and of lengths that are conducive to production paving.

Concrete Pavement with Integral Curb. Pavement and curb constructed monolithically.

Concrete Shoulders. Concrete pavements placed as shoulders.

Miscellaneous Concrete Pavement and Miscellaneous Concrete Overlay. Concrete placed for single-lane ramps, acceleration/deceleration lanes, approaches, intersections, and pavement gaps. Typical sections consist of variable widths and of limited lengths that are not conducive to production paving.

Temporary Concrete Pavement. Concrete pavements constructed for temporary duration.

602.02. Materials

Provide materials in accordance with the following sections:

Curing Materials 903
Epoxy Coated Lane Ties 914
Steel Reinforcement 905
Bond Breaker Material 914
Joint Materials 914
Concrete, Grades 3000, 3500, 3500HP 1004

Provide Grade 3500 or Grade 3500HP for concrete pavement, miscellaneous concrete pavement, concrete overlay, and miscellaneous concrete overlay.

Provide Grade 3000, Grade 3500, or Grade 3500HP for concrete base course, concrete shoulders, and temporary concrete pavement.

The Engineer may approve Grade 3500HP for other applications.

Where concrete shoulders are cast monolithically with concrete pavement, provide the grade required for the concrete pavement.

Provide curing compounds in accordance with subsection 903.06 and the following:

A. Transparent curing compound for base course concrete;

B. White or transparent curing compound for temporary concrete pavement; and

C. White curing compound for other pavement, shoulders, and curb surfaces.

602.03. Construction

A. **Equipment.** Provide and maintain equipment necessary to complete the work.

1. **Fixed Forms and Back-Up Rails.** If paving with fixed forms, use back-up rails attached to the forms to raise equipment wheel flanges clear of previously cast pavement.

   Use metal forms with section rigidity to support the paving.

   Use flexible or standard steel forms with flexible liners where the radius of the curve is less than 150 feet, except where temporary concrete pavement is required.

2. **Compactor.** Use mechanical compactors for constructing aggregate base under the concrete pavement.

3. **Concrete Spreader.** Use a Department-approved device to spread and strike off each layer of concrete and to finish the top layer of concrete. Use a spreader with a weight and rigidity to strike off the concrete to the required grade and profile.

4. **Dowel Bar Inserter (DBI).** The Engineer may allow the use of a DBI instead of load transfer assemblies. Use a Department-approved mechanical DBI that automatically installs load transfer bars at the required depth and consolidates the surrounding concrete.

5. **Lane-Tie Installer.** Use a Department-approved manual or mechanical method for installing lane-ties.

6. **Reinforcement Bridge.** For reinforcement not placed on chairs or mechanically lifted off the grade, transfer the reinforcement from the hauling equipment to a movable bridge that spans the newly cast pavement. Use a bridge that can carry the reinforcement load without deflecting the form or rutting the track line.

7. **Internal Vibrator.** Use mechanical internal vibrators, set in accordance with the manufacturer's specifications, that provide concrete consolidation for a radius of 1 foot around the vibrator head.

   Use a device to monitor the rate of vibration for each concrete vibrator. Verify that all vibrators are operating properly each day, prior to paving and periodically during daily paving operations. Replace any defective vibrators immediately. Connect the vibrators to start automatically with the forward movement of the equipment and stop automatically when the forward movement stops. Space and operate vibrators as recommended by the manufacturer.

8. **Floating and Finishing Equipment.** Shape, screed, and float the concrete to form a dense, homogeneous pavement, requiring only minimum hand finishing.

   Use hand floats and straightedges at least 10 feet long that are rigid and free of warping. Use handles with a length that will allow finishing half the width of the newly placed pavement. Use box or channel hand floats with a floating face at least 6 inches wide.

   The Engineer may approve the use of a roller screed or other manual or semi-automated finishing equipment for one lane-width, miscellaneous, and bridge approach concrete pavements if the Contractor demonstrates that methods and equipment meet the requirements of subsection 602.03.A.3.

9. **Straightedges for Testing Surface Smoothness.** Provide two 5-foot straightedges and one 10-foot straightedge, rigid and free from warping, for the Engineer's use.

10. **Stencils.** Use a template device for imprinting the pavement. Provide numerals that are 3 to 4 inches high and at least ¼ inch deep.

11. **Foot Bridges.** Use at least one moveable bridge for finishing the pavement, installing monument boxes, performing wet checks, and crossing the pavement. Foot bridges spanning slab widths of at least 16 feet must be equipped with wheels, unless they are an integral part

of the paving equipment. Design and construct foot bridges to prevent contact with the concrete.

12. **Membrane Sprayer.** Use mechanical equipment to apply curing compound to exposed pavement surfaces. Use fully atomizing, self-contained spray equipment that is self-supported on wheels or tracks located outside the newly placed pavement. Continuously mix the compound during application. Apply a continuous uniform film of curing compound to exposed concrete surfaces.

    The Engineer may approve hand spraying equipment for small and irregular shapes of new concrete pavement. The sprayer must be capable of applying a uniform film of atomized curing compound at the required rate. Inspect curing compound application equipment before starting daily production to verify its ability to apply the curing compound.

13. **Concrete Saws.** Use a concrete saw for the required application and as recommended by the manufacturer.

14. **Joint Sealing Equipment.** For hot-poured rubber-asphalt type joint sealing compound, use an indirect or double-boiler heating kettle that uses oil as the heat transfer medium. Use a thermostatically controlled heat source, built-in automatic agitator, and thermometers to show the temperature of the melted sealing material and the oil bath. The Engineer may require a demonstration that the equipment will consistently produce a joint sealant of required pouring consistency.

    Equip the kettle with a pressure pump, hose, and nozzle that can place the joint sealant to the full depth of the joint and completely fill the joint. Do not use direct flame heat on the nozzle.

B. **Base Preparation.** Construct and maintain the base to the required line, grade, and cross section, in accordance with subsection 302.03, before pavement placement. Prepare the base, and allow the Engineer to test and accept the base before setting forms or slip-form paving.

    Verify that the paving equipment will maintain the grade tolerance specified for the pavement. If the prepared base is damaged by construction equipment, reconstruct the grade and cross section in accordance with subsection 302.03.C, or as directed by the Engineer, before placing the concrete, at no additional cost to the Department.

C. **Placing Forms.** Trim the compacted base close to the staked grade using base preparation equipment. Check the base for line and grade, and correct irregularities before placing the forms. Compact the base outside the area to be paved, to support the forms.

Clean forms of hardened concrete or mortar that would alter the shape or finish elevation of the anticipated concrete placement. Set forms, providing uniform bearing of the forms directly on the base throughout their length and width. Securely join, lock, stake, and brace each form segment. Do not allow vertical movement to exceed ⅛ inch and horizontal movement to exceed ¼ inch during concrete placement.

After the forms are set, provide time for the Engineer to check them. If requested by the Engineer, fabricate string lines for checking line and grade. Adjust form lines that vary from the staked line by more than ½ inch, or from the staked grade by more than ⅛ inch.

Treat the inside of all forms with a release agent that will not discolor or adversely affect the concrete. Do not allow the release agent to come in contact with steel reinforcement, lane ties, or existing concrete surfaces.

D. **Placing Concrete.** Set structure castings to grade and alignment before, or during, concrete placement. The boxing-out method for concrete base course and temporary concrete pavement will be allowed. Clean structure castings to allow adhesion of the concrete.

Place concrete on a moist base. Do not place concrete on a frozen base or an unstable base.

Keep the top of the forms clean and free of concrete during placing and finishing.

Inspect vertical surfaces of previously placed concrete and the adjacent grade, and remove material that would prevent the adjoining concrete pour from consolidating or conforming to the plan dimensions.

If an open-graded base is used, inspect the graded base for contamination from fines or debris, prior to paving. If the Engineer determines that contaminated material requires removal or replacement, remove and replace at no additional cost to the Department.

When the Engineer determines that damage occurs to the base course from hauling units, discontinue production until the cause of the damage has been evaluated and corrected.

Spread and strike off the concrete as soon as it is deposited on the base and avoid segregation. Consolidate the concrete with internal vibrators. Provide additional vibration as needed to properly consolidate concrete adjacent to the faces of fixed forms and next to transverse dowel bar assemblies. Do not use vibrators for flowing or spreading concrete.

When using the slip-form method, vibrate concrete for the full width and depth of the pavement. Where placing the concrete in two layers, the consolidation may occur after placing the top layer.

Continually monitor the operation of vibrators mounted on the paving machine. Do not commence paving until it is demonstrated to the satisfaction of the Engineer that vibrators are operating in accordance with the manufacturer's specifications. If a vibrator malfunctions during paving, discontinue paving operations and correct the malfunction. Resume paving when malfunctions are corrected and the Engineer approves.

Cease vibration and tamping when the paving equipment stops.

Provide a continuous paving operation. The Engineer may stop production if there is not sufficient equipment or labor to keep pace with the other paving operations. When placing the concrete in two layers, place the top layer of concrete within 30 minutes of placing the bottom layer. Place a transverse end-of-pour joint (Symbol H) when unavoidable interruptions of concrete placement occur that are longer than 60 minutes from the time the concrete is batched until final finishing of the concrete surface.

Operate equipment to prevent damage to pavements and bridge decks and to maintain the required grade in transitioning from the pavement to the deck.

Do not allow vehicles or equipment, other than joint saws or ride-quality measurement equipment, on new pavement or portions of new pavement until the concrete reaches a strength in accordance with subsection 104.11.

Keep existing pavements clean of materials that may interfere with finishing operations or cause damage to the concrete surface.

Where placing slip-form pavement in two layers, each side of the first layer may be cast narrower than the width of the proposed pavement slab by 3 inches and at least twice the largest dimension of the concrete aggregate, but not more than 6 inches. Cast full-depth pavement at the edges with the second layer.

Unless otherwise specified, finish concrete placed each day during daylight, or provide artificial light at no additional cost to the Department, as approved by the Engineer.

E. **Placing Reinforcement.** Place reinforcement that is free of loose rust and other contaminants.

1. **Welded Wire Fabric.** Place steel welded wire fabric for concrete pavements from a reinforcement bridge or by other methods that will not contaminate the concrete as approved by Engineer.

2. **Bar Reinforcement.** Place steel bar reinforcement for concrete bridge approach pavements in accordance with subsection 706.03, *MDOT Standard Plan R-45* series, and as shown on the plans.

F. **Constructing Joints**. Install epoxy-coated lane ties or deformed bars in accordance with Standard Plan R-41 series.

1. **Longitudinal Lane-Tie Joints with Straight Tie Bars (Symbol D and Symbol S).** Place longitudinal lane-tie joints with straight tie bars (Symbol D and S) in accordance with *MDOT Standard Plan R-41* series. Use Department-approved chairs or mechanical devices to support bars. Do not place lane-tie bars in the concrete by hand methods.

   Unless otherwise required in the contract, installation of lane-tie bars is not required for temporary concrete pavement.

2. **Longitudinal Bulkhead Joints (Symbol B).** Place longitudinal bulkhead joints (Symbol B) in accordance with *MDOT Standard Plan R-41* series. Protect the free-edge longitudinal joint until adjacent pavement is placed. Install the bent bars to allow consolidation around the bars without causing concrete slumping at the edges. Straighten bent tie bars after the concrete has gained required strength. Straighten tie bars to run parallel to the surface of the pavement and perpendicular to the edge of the pavement. Inspect the bars to determine whether the epoxy coating is damaged after straightening the bars. Repair tears or loosening of the epoxy coating within 6 inches of the joint face using the coating material recommended by the coating manufacturer.

3. **Pull-out Resistance Testing for Adhesive Anchored Lane-Tie Bars.** Pull-out resistance testing is required for lane-tie bars that are adhesive anchored into the hardened concrete. Pull-out resistance testing is not required for lane-tie bars that are cast into the fresh concrete.

   Lane-tie bar pull-out resistance must meet the requirements in Table 602-1. If the test results for the lane-tie bars from the first day of placement meet the requirements of Table 602-1, the Engineer will determine the need for additional testing.

   If the average pull-out resistance is less than the minimum requirements in Table 602-1, provide a plan to the Engineer for approval. The plan should detail how additional epoxy-anchored lane-tie bars will be added to provide proper load transfer. Install anchored lane-tie bars in accordance with the approved plan at no

additional cost to the Department. Do not place adjacent pavement until the Engineer tests the additional lane-tie bars.

The Engineer may waive verification tests for projects with less than 1,000 feet of longitudinal bulkhead joints.

Table 602-1:
Lane-Tie Pull-Out Resistance

Distance from Joint Being Constructed to Nearest Free Edge of Completed Pavement[a]	Average Pull-out Resistance (lb minimum per foot of joint)[b],[c]
≤12 feet	2,200
>12 feet through 17 feet	3,200
>17 feet through 24 feet	4,500
>24 feet through 28 feet	5,200
>28 feet through 36 feet	6,800
≥36 feet	—[d]

(a) Includes combinations of tied lane widths, valley gutter, curb and gutter, or concrete shoulder.
(b) Slippage must not exceed $^{1}/_{16}$ inch.
(c) Refer to the *Materials Quality Assurance Procedures Manual* for inspection procedure.
(d) As directed by the Engineer.

4. **Transverse Joints.** Construct transverse contraction, expansion, and plane-of-weakness joints in pavements as shown on the MDOT Standard Plans.

   Unless otherwise shown on the plans, construct transverse joints perpendicular to the pavement centerline.

   Where placing pavement in partial-width slabs, place transverse joints in line with like joints in the adjacent slab. Where widening existing pavements, place transverse joints in line with like joints in the existing pavement and in line with “working” cracks that function as joints, or as directed by the Engineer.

   Provide load-transfer assemblies manufactured in accordance with the MDOT Standard Plans. The Engineer will reject damaged, deformed, or nonconforming load transfer assemblies. Stake the load transfer assemblies in place. Do not cut the shipping tie wires. Allow time for the Engineer to check the assemblies for condition, line, and grade before placing concrete. Permanently mark dowel bar locations on the vertical face of the plastic concrete pavement to accurately identify and locate joints for subsequent sawing.

For expansion joints, equip the free end of the bar with a close-fitting cap in conformance with the MDOT Standard Plans.

Where using more than one section of premolded joint filler in a joint, tightly butt the sections together. Place the bottom edge of the premolded filler in contact with the base and the top edge at the required depth below the surface of the pavement. Place the expansion joint filler perpendicular to the surface and the centerline of the pavement.

Construct end-of-pour joints in accordance with the MDOT Standard Plans.

If using a DBI to install load transfer bars, space the bars in accordance with *MDOT Standard Plan R-40* series. Place and consolidate the pavement full-depth before inserting the dowel bars. Permanently mark dowel bar locations on the vertical face of the plastic concrete pavement for accurate identification and location of joints for subsequent sawing.

Insert dowel bars into the full-depth plastic concrete, and consolidate the concrete around the dowel bars, leaving no voids. Do not use hand-held vibrators. Align dowel bars in the vertical and horizontal planes to within ½ inch for the entire length of the bar. Center dowels bars longitudinally within 2 inches of the location of the transverse joint shown on the plans.

Verify the inserted dowels meet the required tolerances. The Engineer will witness these measurements. Provide documentation, if requested by the Engineer. Perform daily wet checks of the dowel bars at a minimum frequency of one wet check every 500 feet and as required by the concrete QC plan. Mark and replace joints that are out of tolerance at no additional cost to the Department.

Locate the night header at a transverse joint location. Place a test joint beyond the night header to remove for testing. Saw the test joint full-depth, to expose the ends of the dowels, 14 inches wide over the center of the joint (7 inches each side of the center of the joint), and remove the test header for inspection of the dowel bar placement before restarting the concrete pavement operation. The minimum width of area to be removed must equal the width of the slab being placed on the project. Install dowels in the night header in drilled and adhesive anchored, or preformed holes after removal of the test joint. If the Contractor uses a continuous paving operation that does not stop, the Engineer will establish the test joint location. Unless otherwise directed by the Engineer, a minimum of three acceptable test joints are required per direction of paving for the project.

Saw transverse contraction and expansion joints in accordance with subsection 602.03.N.

5. **Intersection Joint Layout.** Develop a plan showing the intended layout of the joints, including clear labeling of proposed joint types. The intersection joint layout plan must be submitted to the Engineer for review a minimum of 7 days prior to concrete placement. Any comments or proposed changes to the plan will be returned for revision to produce an approved joint layout plan prior to concrete placement.

   Construct intersection joints in pavements as shown on the approved intersection joint layout plan.

   Saw intersection joints in accordance with subsection 602.03.N.

G. **Screeding.** Screed and consolidate concrete pavement to achieve the final cross section shown on the plans. Use machine methods that avoid material segregation.

   The Engineer may allow the use of manual methods for concrete pavement gaps less than 160 feet long and no greater than one lane width wide, or if the pavement is entirely concrete base course.

   Do not use water to enhance finishing operations.

H. **Finishing Surface.** Screed or extrude the finished surface to a smooth, sealed, and uniform appearance in accordance with the final cross section shown on the plans.

I. **Straightedge Testing, Surface Correction, and Edging.** While the concrete is still plastic, test the slab surface and structure castings for compliance with the required grade and cross section using a 10-foot straightedge, or other method if approved by the Engineer.

   If high or low spots exceed ⅛ inch over 10 feet, suspend paving operations and correct the finishing procedures. Correct high or low spots in pavements that exceed the tolerance and obtain the Engineer's approval before resuming paving operation.

   The Engineer will evaluate high or low spots in the hardened concrete slab surface, including structure castings, that exceed ½ inch over 10 feet, or ¾ inch over 50 feet, in accordance with subsection 104.04.

   In locations where the hardened concrete slab interfaces with either a newly constructed pavement, sleeper slab, approach slab, or expansion joint, the Engineer will evaluate high or low spots on either surface, including the interface between the two surfaces, that exceed ½ inch over 10 feet in accordance with subsection 104.04.

Correct high or low spots in pavements that exceed these tolerances at no additional cost to the Department.

Correct edge settlement that exceeds ⅜ inch before the concrete hardens. Suspend paving if edge settlement exceeding ¼ inch continues for at least 10 feet, and make corrections before resuming paving.

Do not leave overhanging projections on pavement edges, except on temporary concrete pavement.

J. **Ride Quality.** Provide ride quality as required by the contract.

K. **Texturing.** When the pavement sets and will maintain a texture, drag the surface longitudinally using one or two layers of damp burlap. Maintain contact between the burlap and the concrete surface across the entire width of newly placed concrete.

Immediately after dragging, groove pavement surfaces other than concrete base courses and shoulders. Unless otherwise shown on the plans, use a steering-controlled machine to orient the grooves parallel to the longitudinal joint. Prevent noticeable wander, overlap, or wave pattern in the grooves. Do not allow the groove edges to slump at the edges or severely tear the concrete surface. Place grooves with a width and depth of ⅛ inch, with a tolerance of 1/32 inch, spaced ¾ inch on center with a tolerance of 1/16 inch. Do not groove the pavement surface within 1½ inches of longitudinal joints. Provide a mean texture depth from 0.04 inch to 0.10 inch, in accordance with ASTM E965.

For areas requiring turf-drag texturing, produce the texture and required mean texture depth by longitudinally dragging an artificial turf material to produce a uniform pattern parallel to the centerline. Maintain continual and uniform contact with the plastic concrete over the entire area being textured. Periodically clean turf material to maintain a uniform texture. Provide a mean texture depth at least 0.03 inch, in accordance with ASTM E965.

For miscellaneous pavement, the use of a manual texturing device with a texture rake at least the same width as the plastic concrete pavement will be allowed.

When transverse grooving is required, orient the grooves perpendicular to the centerline and form the grooves in the plastic concrete. Do not allow the grooves to slump at the edges or severely tear the concrete surface. Place grooves with a width and depth of ⅛ inch, with a tolerance of 1/32 inch, spaced ¾ inch on center, with a tolerance of 1/16 inch.

Texture the plastic concrete before applying curing compound. If the Engineer determines that the texturing operations are delaying the

application of the curing compound, stop the texturing operation, and complete the application of curing compound.

If texturing is not complete before placing curing compound or if the pavement is not textured as required, complete the surface texturing of the hardened concrete, at no additional cost to the Department, after the pavement achieves the minimum required class design strength. Correct pavement surfaces by grooving the hardened concrete longitudinally with a width and depth of ⅛ inch and a tolerance of 1/32 inch, spaced ¾ inch on center with a tolerance of 1/16 inch on center. Submit a corrective action plan, including collection and disposal of the residue from retexturing, for the Engineer's approval.

L. **Stenciling Pavement.** After texturing, stencil survey station numbers into the pavement surface. Stencil station numbers 16 inches from the edge of the pavement. Place numbers perpendicular to the centerline of the roadway, legible from a vehicle traveling in the direction of traffic. On two-way roads, stencil station numbers to read in the direction of stationing.

Stencil the month, day, and year into the concrete pavement at the beginning and end of each day's pavement operation, near the edge of the slab opposite the edge used for stationing. Place the date so it can be read if facing in the direction of pavement placement.

Do not stencil concrete base courses and temporary pavements.

Mark underdrain outlets in concrete shoulders, in accordance with subsection 404.03.F. Stencil the marker into the concrete surface, after texturing.

M. **Curing.** Curing operations will take precedence over texturing in accordance with subsection 602.03.K.

Cure the concrete as soon as the free water leaves the surface of the pavement. Coat and seal the pavement surface and sides of slip-formed pavement with a uniform layer of membrane curing compound.

Apply one coat of curing compound on non-grooved surfaces and two coats on grooved surfaces. Apply at least 1 gallon per 25 square yards of surface for each coat. Apply the second coat after the first coat dries, but do not allow more than 2 hours between coats.

Maintain a thoroughly mixed compound in accordance with the manufacturer's recommendation. Do not thin curing compound.

For miscellaneous concrete pavement more than one lane wide, apply the compound from a foot bridge, if using a manually operated pressure-type sprayer.

Immediately reapply curing compound to surfaces damaged by rain, joint sawing, Contractor foot traffic, or other activities.

If fixed-forms are removed within the 7-day curing period, coat the sides of the pavement with curing compound immediately after removing the forms.

If using cold-weather protection during the curing period, curing compound may be omitted if approved by the Engineer. Apply curing compound immediately after removing cold-weather protection.

Repair or replace concrete showing injury or damage due to inadequate curing at no additional cost to the Department.

N. **Sawing Joints.** Saw joints as shown on the MDOT Standard Plans. The use of a concrete saw on new pavement to saw the joints is allowed. The water supply truck is not allowed on new pavement until the pavement has attained the strength specified in subsection 104.11.

Immediately stop sawing operations if sawing causes raveling, spalling, or damage to the concrete surface. Continue to monitor the concrete hardness before resuming sawing operation.

1. **Longitudinal Joints.** Saw longitudinal joints (Symbol D). Start sawing operation after the concrete pavement hardens but before random cracks develop in the concrete pavement.

2. **Transverse Contraction and Expansion Joints.** Construct the joint groove in expansion joints as shown on the MDOT Standard Plans. Flush loose concrete and slurry from the groove and the immediate area.

   If the required seal is not installed within 7 days of final sawing, temporarily seal the joint groove with a Department-approved material or device to prevent the infiltration of foreign material.

   Install either the permanent seal or a temporary seal before allowing vehicles to travel over the full-width joint grooves.

   Saw joints in two stages, in accordance with the following:

   a. Place a relief cut directly over the center of the load transfer assembly or over the preformed joint filler. Make the relief cut after the concrete hardens and will not excessively ravel or spall, but before random cracks develop in the concrete pavement. Immediately stop sawing if sawing operation causes excessive raveling or spalling, and continue to monitor the concrete hardness before resuming sawing operations. Do not allow traffic over the expansion-joint relief cuts.

b. Center the joint groove over the relief cut. Immediately stop sawing if sawing operation causes excessive raveling or spalling, and continue to monitor the concrete hardness before resuming sawing operations. Maintain the curing of the concrete near the joint and, if required, install the permanent joint sealant or place temporary cover material. Give second-stage sawing of expansion joints priority over second-stage contraction joint sawing, if higher pavement temperatures are forecast.

If proposing an alternative method for sawing, submit a plan to the Engineer for approval. Alternate methods will not be allowed if they cause spalling, raveling, and random cracks in the concrete pavement.

Repair raveling or spalling in accordance with subsection 602.03.P. Remove and replace random cracked panels as directed by the Engineer, at no cost to the Department.

The MDOT Standard Plans specify the location of the transverse joint in the pavement, shoulder, curb and gutter, valley gutter, or base course, if the joint requires a load transfer assembly, expansion joint filler, or both, and the type of sealant or seal required.

O. **Pavement Thickness.** The Department will determine payment in accordance with subsection 602.04. Coring for QC purposes is not allowed unless approved by the Engineer.

P. **Patching Joints.** After sawing and cleaning the joints, inspect for spalls and voids. Remove loose, unsound, or damaged concrete as directed by the Engineer. Repair joints in concrete base course and temporary concrete pavement for intermediate and major spalls. Perform all spall repairs at no additional cost to the Department.

1. **Minor Spalls.** Minor spalls or voids are defined as those that do not exceed 1 inch beyond the vertical joint face shown in the MDOT Standard Plans.

Saw cut spalls parallel to the joint groove at the outer extremity of the spalled area. Sandblast the spalled concrete surface. Blow the patch clean with a jet of oil-free compressed air.

Clean concrete surfaces according to subsection 602.03.R.

Seal minor spalls according to subsection 602.03.S.

2. **Intermediate Spalls.** Intermediate spalls are defined as those that do not exceed 4 inches in width by 2 feet in length along the direction of the joint and are not greater than 4 inches deep. No more than 3 non-continuous linear feet of intermediate spall is permitted per

transverse joint, or per panel for longitudinal joint, or as determined by the Engineer.

Saw cut spalls parallel to the joint groove at the outer extremity of the spalled area. Cut at least 2 inches deep. Chip the concrete out to the saw cut to form a vertical face at the back of the repair area. Cut the two ends of the repair area to form vertical faces. Sandblast the entire area to remove loose particles. Blow repair area clean with a jet of oil-free compressed air to remove the sand and other loose material.

Select a material for intermediate spall repair according to subsection 914.05.

3. **Major Spalls.** Major spalls are those exceeding the dimensional thresholds described for intermediate spalls. Repair major spalls according to *MDOT Standard Plan R-44* series.

Q. **Repair of Longitudinal Joints and Edges.** Patch spalls that occur between adjacent lanes of concrete pavement and at edges in accordance with subsection 602.03.P.

Where a concrete pavement abuts an HMA surface, patch spalls that extend more than 1 inch from the vertical joint face and more than 1 inch below the surface of the pavement. If the cumulative total of spall lengths exceeds 20 feet per mile of pavement joint, patch spalls less than 1 inch from the vertical joint face and more than 1 inch below the surface of the pavement.

The Engineer will direct the repair of spalls greater than 36 square inches within 10 feet of longitudinal joint or edge. Remove and replace the pavement if so directed by the Engineer at no additional cost to the Department.

R. **Cleaning Joints.** Clean joints, including the surface of the pavement next to the joint groove, with appropriate tools and equipment to remove slurry, stones, or other loose material.

Ensure the vertical faces of the prepared joint meet the concrete surface profile 2 (CSP 2) as defined by the International Concrete Pavement Repair Institute. Joints must be clean and dry with no sign of debris, residue, and surface moisture prior to installing joint sealant material.

S. **Sealing Joints.** Seal longitudinal and transverse joints as shown on the plans.

Do not use artificial heat to dry joints before sealing.

Seal the joints immediately after cleaning. Verify that the joint surfaces are dry before sealing. Place sealant when the concrete temperature is at least 40°F and rising without the use of artificial heat.

Melt sealant in a heating kettle; do not heat directly. Do not use sealants that are heated to more than the safe heating temperature recommended by the manufacturer.

Apply hot-poured joint sealant using a pressure applicator with a nozzle that extends into the groove. Remove sealant from the surface of the pavement. Before allowing traffic over the sealed joint, cure the sealant to resist pickup.

T. **Weather and Temperature Limitations**

1. **Protection Against Rain.** Protect the concrete pavement from damage by rain.

2. **Protection from Cold Weather.** Protect the concrete pavement from freezing until it attains a compressive strength of at least 1,000 psi. Remove and replace concrete slabs damaged by cold weather, as directed by the Engineer, and at no additional cost to the Department.

3. **Cold Weather Limitations.** Do not place concrete pavement until the ambient air temperature away from artificial heat is at least 25°F and rising, unless otherwise approved by the Engineer. Do not place concrete pavement if portions of the base, subbase, or subgrade layer are frozen, or if the grade exhibits poor stability from excessive moisture. Protect the concrete surfaces using insulating blankets or polystyrene insulation with a minimum R-value of 7.0 if the National Weather Service forecasts air temperatures below 40°F for more than 8 consecutive hours during the curing period. Plastic sheeting may be used instead of insulating blankets or polystyrene insulation if the National Weather Service forecasts air temperatures above 32°F during the curing period.

4. **Hot Weather Limitations.** Protect concrete pavement during hot weather as required by the concrete QC plan. Protect the concrete pavement if the rate of evaporation is equal to or greater than 0.20 psf per hour, in accordance with Figure 706-1.

   Use equipment, approved by the Engineer, for determining the relative humidity and wind velocity at the concrete pavement site.

5. **Concrete Temperature Limitations.** At the time of concrete placement, ensure a concrete temperature from 45°F to 90°F.

602.04. Measurement and Payment

Pay Item	Pay Unit
Conc Pavt, Reinf, __ inch	Square Yard
Conc Pavt, Bridge Approach, Reinf	Square Yard
Conc Pavt, Bridge Approach, Reinf, High Performance	Square Yard
Conc Pavt, Nonreinf, __ inch	Square Yard
Conc Pavt, Nonreinf, __ inch, High Performance	Square Yard
Conc Pavt with Integral Curb, Reinf, __ inch	Square Yard
Conc Pavt with Integral Curb, Nonreinf, __ inch	Square Yard
Conc Pavt, Misc, Reinf, __ inch	Square Yard
Conc Pavt, Misc, Nonreinf, __ inch	Square Yard
Conc Pavt, Misc, Nonreinf, __ inch, High Performance	Square Yard
Conc Pavt, Reinf, __ inch, Temp	Square Yard
Conc Pavt, Nonreinf, __ inch, Temp	Square Yard
Conc Base Cse, Reinf, __ inch	Square Yard
Conc Base Cse, Nonreinf, __ inch	Square Yard
Shoulder, Reinf Conc	Square Yard
Shoulder, Nonreinf Conc	Square Yard
Shoulder, Nonreinf Conc, High Performance	Square Yard
Shoulder, Freeway	Square Yard
Conc Pavt, Ovly, Furnishing and Placing	Cubic Yard
Conc Pavt, Ovly, Furnishing and Placing, High Performance	Cubic Yard
Conc Pavt, Ovly, Finishing and Curing	Square Yard
Conc Pavt, Ovly, Finishing and Curing, High Performance	Square Yard
Conc Pavt, Ovly, Misc, Furnishing and Placing	Cubic Yard
Conc Pavt, Ovly, Misc, Furnishing and Placing, High Performance	Cubic Yard
Conc Pavt, Ovly, Misc, Finishing and Curing	Square Yard
Conc Pavt, Ovly, Misc, Finishing and Curing, High Performance	Square Yard
Pavt Gapping	Foot
Joint, Contraction, (type)	Foot
Joint, Contraction, (type), Intersection	Foot
Joint, Expansion, (type)	Foot
Joint, Expansion, (type), Intersection	Foot
Joint, Plane-of-Weakness, (type)	Foot
Joint, Plane-of-Weakness, (type), Intersection	Foot
Conc, Grade __	Cubic Yard

A. **Concrete Pavement and Base Course.** The Engineer will measure, and the Department will pay for, concrete pavement and base course by area, based on plan quantities in accordance with subsection 109.01. The Department will establish pay items based on the type of pavement

installed, the pavement thickness required, and whether reinforcement is required.

The Engineer will measure concrete pavement with integral curb by area, including the curbs.

The Engineer will measure transition areas between concrete valley gutter and concrete curb and gutter, and concrete valley gutter cast integrally with concrete pavement at the apex of gore areas, by dividing the area in half and measuring each half using the units of adjacent pay items.

The unit prices for other pavement and base course pay items include the cost of concrete headers abutting bridges and track crossings constructed by thickening the pavement.

The unit prices for **Conc Pavt, Misc, Reinf; Conc Pavt, Misc, Nonreinf; Conc Pavt, Misc, Nonreinf, High Performance, Conc Pavt, Bridge Approach, Reinf;** and **Conc Pavt, Bridge Approach, Reinf, High Performance** of the thicknesses required, include the cost of additional concrete additives if concrete pavement for pavement gapping requires additives to meet minimum opening-to-traffic strength requirements.

B. **Concrete Shoulder**

1. **Shoulder, Reinf Conc; Shoulder, Nonreinf Conc;** and **Shoulder, Nonreinf Conc, High Performance.** The Engineer will measure, and the Department will pay for, **Shoulder, Reinf Conc**; **Shoulder, Nonreinf Conc;** and **Shoulder, Nonreinf Conc, High Performance** by area, based on plan quantities in accordance with subsection 109.01.

2. **Shoulder, Freeway.** The Engineer will measure, and the Department will pay for, **Shoulder, Freeway** based on plan quantities in accordance with subsection 109.01. If the Contractor uses concrete for the shoulder, the unit price for **Shoulder, Freeway** includes the cost of the transverse joints in the shoulder and the external longitudinal pavement joints.

C. **Concrete Overlay**

1. **Concrete Pavement, Overlay Furnishing and Placing.** The Engineer will measure, and the Department will pay for, **Conc Pavt, Ovly, Furnishing and Placing;** and **Conc Pavt, Ovly, Furnishing and Placing, High Performance** on concrete pavements and shoulders, including providing and placing the concrete mixture, by volume. The Engineer will determine the volume based on in-place quantities.

2. **Concrete Pavement, Overlay Finishing and Curing.** The Engineer will measure **Conc Pavt, Ovly, Finishing and Curing** and **Conc Pavt, Ovly, Finishing and Curing, High Performance** in place. The unit price for **Conc Pavt, Ovly, Finishing and Curing** and **Conc Pavt, Ovly, Finishing and Curing, High Performance** includes the cost of finishing and curing concrete pavements and shoulders, finishing and curing the concrete overlays, and constructing longitudinal joints.

   The Engineer will measure, and the Department will pay for, constructing transverse joints, in accordance with subsection 602.04.E, and for repairing and removing the existing pavement, in accordance with subsection 603.04.B.

3. **Concrete Pavement, Overlay, Miscellaneous Furnishing and Placing and Concrete Pavement, Overlay, Miscellaneous Finishing and Curing.** The unit prices for **Conc Pavt, Ovly, Misc, Furnishing and Placing; Conc Pavt, Ovly, Misc, Furnishing and Placing, High Performance; Conc Pavt, Ovly, Misc, Finishing and Curing;** and **Conc Pavt, Ovly, Misc, Finishing and Curing, High Performance** include the cost of reconstructing ramps, ramp overlays, gore areas, and approach areas. The Engineer will measure, and the Department will pay for, **Conc Pavt, Ovly, Misc, Furnishing and Placing** and **Conc Pavt, Ovly, Misc, Furnishing and Placing, High Performance** in accordance with subsection 602.04.C.1. The Engineer will measure, and the Department will pay for, **Conc Pavt, Ovly, Misc, Finishing and Curing** and **Conc Pavt, Ovly, Misc, Finishing and Curing, High Performance** in accordance with subsection 602.04.C.2.

   Substituting higher grades of concrete for lesser grades of concrete will be allowed at no additional cost to the Department.

D. **Pavement Gapping.** The Engineer will measure **Pavt Gapping** by the length parallel to the centerline of the project from the beginning of concrete to the end of concrete, within the gapped section. The Engineer will measure each individual lane of gapped concrete pavement separately. The unit price for **Pavt Gapping** includes the cost of interrupting paving operations, moving back to pave the gap, and maintaining cross traffic.

   The unit prices for other pay items include the cost of gapping curbs, curb and gutter, gutters, driveways, and sidewalks.

E. **Joints.** The unit prices for other pay items include the cost of transverse end-of-pour joints (Symbol H) and transverse plane-of-weakness joints

(Symbol U). The Department will pay for other transverse joints by the length, based on plan dimensions, for the type of joint required.

The unit price for the transverse contraction, transverse expansion, transverse plane-of-weakness, and intersection joints include the cost of the following:

1. Providing required joint materials such as load transfer assemblies, expansion joint fillers, and joint seals or sealants;
2. Providing a joint layout detail plan, if required;
3. Sawing, forming, and cleaning the joints;
4. Providing and applying bond breaker, if required; and
5. Providing and placing poured joint sealant.

The Engineer will measure, and the Department will pay for, expansion or contraction joints for concrete shoulders, shown on the plans, based on plan dimensions.

The unit prices for other pay items include the cost of internal and external longitudinal joints.

F. **Price Adjustment for Pavement, Shoulder, and Base Course Based on Thickness and Depth of Reinforcement.** The Engineer will core the concrete pavement before final acceptance to determine the thickness of the concrete pavement, and if required, the depth of reinforcement below the pavement surface. The Engineer will only measure the top layer of steel for depth of concrete cover for concrete pavements with two layers of required reinforcement.

The Engineer will not core the following:

1. Temporary concrete pavement;
2. Pavement within 4 feet of an obstruction;
3. Pavement areas less than 300 square yards; or
4. Pavement less than 3 feet wide.

The Engineer will determine concrete pavement units, core locations, and evaluate cores in accordance with Michigan Test Method (MTM) 201.

The Department will adjust the contract unit price for areas of concrete pavement where thicknesses or reinforcement locations exceed required tolerances. The Engineer will use Table 602-2 to classify cores and determine price adjustments according to concrete pavement thickness. The Engineer will use either Table 602-3A or Table 602-3B to classify cores and determine price adjustments according to steel depth. The

Department will apply these adjustments cumulatively to the evaluated pavement unit.

5. **Initial Core.** The Engineer will classify each initial core with a one- or two-letter core-type code. The first letter (A, B, or C) represents the thickness classification in accordance with Table 602-2 and the second letter (X, Y, or Z), represents the steel depth classification in accordance with Table 602-3A.

   If the Engineer classifies an initial core from a concrete pavement unit as Type AX, indicating both thickness and steel depth are within required tolerances, the Department will not apply an adjustment and the Engineer will take no additional cores.

6. **Additional Cores.** If the Engineer does not classify an initial core from a concrete pavement unit as Type AX, the Engineer will take additional cores. The Department will only consider the dimensions not within the A or X range for adjustment based on subsequent cores. The Engineer will decide whether to accept the work, make a price adjustment of up to 100%, or direct the Contractor to remove and replace concrete pavement, based on the initial and additional cores.

7. **Price Adjustment for Thickness**

   a. **Initial Core Type A.** The Department considers a Core Type A to have a thickness within the required tolerances. The Engineer will not take additional cores to measure thickness, and the Department will not apply a price adjustment to the concrete pavement unit.

   b. **Initial Core Type B.** The Department considers a Core Type B to deviate from the design thickness as shown in Table 602-2. The Engineer will take two additional cores and measure the thickness.

      The Engineer will calculate the average thickness for the concrete pavement unit. In determining the average thickness, the Engineer will record measurements of individual cores that exceed the required pavement thickness by more than ¼ inch as the required thickness plus ¼ inch.

      The Department will determine the unit price adjustment using the average thickness rounded to the nearest 0.1 inch, and Table 602-2.

   c. **Initial Core Type C.** The Department considers a Core Type C to deviate from the design thickness by more than 1.1 inches.

      The Engineer will take straddler cores to determine the area of deficiency.

The Engineer will establish a new initial core for the concrete pavement unit, excluding the deficient area, and repeat the evaluation and calculation for the concrete pavement thickness.

Remove and replace deficient areas in accordance with subsection 602.04.F.5.

8. **Price Adjustments for Steel Locations within the Pavement.** The Department will consider two variables when considering price adjustments for steel depth: the steel location relative to the pavement surface and the deviation of the steel location from the allowable depth range. The Department will determine both and apply only the larger of the two deviations from the requirements in Table 602-3A and Table 602-3B.

   a. **Initial Core Type X.** The Department considers a Core Type X to have reinforcement placed within the required tolerances for depth from surface of pavement. The Engineer will not take additional cores, and the Department will not make a price adjustment to the concrete pavement unit for reinforcement placement.

   b. **Initial Core Type Y.** The Department considers Core Type Y to contain reinforcement that deviates from the design depth. The Engineer will take two additional cores and measure the depth of steel from concrete pavement surface for each core.

      The Engineer will calculate the average reinforcement depth.

      The Engineer will use the average reinforcement depth and Table 602-3A to determine the price adjustment based on the location of the steel from the concrete pavement surface.

      The Engineer will calculate the absolute deviation from the limits of the design depth range for each core, and the average absolute deviation from the required depth range.

      The Engineer will use the average absolute deviation and Table 602-3B to determine the contract price adjustment based on deviation from required depth of steel range.

   c. **Initial Core Type Z.** The Department considers Core Type Z to contain reinforcement that deviates from the design depth by more than the required tolerance.

      The Engineer will take straddler cores to determine the area of deficiency.

The Engineer will establish a new initial core for the concrete pavement unit, excluding the deficient area, and repeat the evaluation and calculation of depth of steel.

Remove and replace the deficient area in accordance with subsection 602.04.F.5.

9. **Remove and Replace.** If an initial core falls into either the Core Type C or Core Type Z category, the Engineer will delineate the deficient area by taking straddler cores at 5-foot intervals, longitudinally, in both directions from the initial core. The Department will consider defective areas separately from the remainder of the concrete pavement unit. The Contractor will remove and replace Core Type C and Core Type Z areas as directed by the Engineer. The Contractor will remove an area of pavement at least 10 feet long, for the full panel width. If the area designated for removal is within 15 feet of a transverse joint, the Contractor will remove the defective concrete pavement area to the joint. The Engineer will core and evaluate the replaced areas in accordance with subsection 602.04.F. If the concrete pavement is within the tolerances specified in Table 602-2, Table 602-3A, and Table 602-3B, the Department will pay for the replaced concrete pavement at the contract unit price.

Table 602-2:
Price Adjustment for Concrete Thickness Deficiency

Initial Core Type	Deficiency in Thickness (inch)	Price Adjustment
A	≤0.2	0%
B	0.3	−5%
B	0.4	−15%
B	0.5	−25%
B	0.6–1.0	−50%
C	≥1.1	−100%[(a)]

(a) Corrective action up to and including removing and replacing pavement

Table 602-3A:
Price Adjustment for Depth of Steel from Pavement Surface

Core Type	Tolerance on Depth of Reinforcement for Uniform Plan Thickness (inch)[a],[b],[c]					Price Adjustment
	7.75–8.50	8.75–9.50	9.75–10.50	10.75–11.50	Shoulder	
Z	0.0–0.9	0.0–0.9	0.0–0.9	0.0–0.9	0.0–0.9	−100%[d]
Y	1.0–1.9	1.0–1.9	1.0–1.9	1.0–2.4	1.0–2.4	−25%[d]
X[e]	2.0–4.0	2.0–4.5	2.0–5.0	2.5–5.5	2.0–4.0	0%
Y[e]	4.1–4.8	4.6–5.4	5.1–6.0	5.6–6.6	4.1–5.0	−25%
Y[e]	4.9–6.4	5.5–7.2	6.1–8.0	6.7–8.8	≥5.1	−50%
Z[e]	≥6.5	≥7.3	≥8.1	≥8.9	—	−100%[d]

(a) If the contract requires a pavement reinforced with two layers of reinforcement, the Engineer will only measure the depth of the top layer of steel.

(b) To determine pavement thicknesses, use the same depth range as the pavement the shoulder is tied to. Use the average shoulder thickness, if tapered.

(c) Pavement or base course.

(d) Corrective action up to and including removing and replacing pavement.

(e) If a core length measures at least 0.2 inch over the plan thickness, increase the maximum depth range by one-half the excess core length over the plan thickness, round to the nearest 0.1 inch, in accordance with ASTM E29, and then add it to the range shown.

Table 602-3B:
Price Adjustment for Deviation of Depth of Steel from Design Range Initial

Core Type	Allowable Average Absolute Deviation from Design Depth of Reinforcement per Uniform Plan Thickness (inch)[a],[b],[c]					Price Adjustment
	6.5–7.5	7.75–8.5	8.75–9.5	9.75–10.5	11–13	
X[d]	0.0–0.5	0.0–0.5	0.0-0.5	0.0–0.5	0.0–0.5	0%
Y[d]	0.5–1.0	0.5–1.0	0.5–1.0	0.5–1.0	0.5–1.0	−10%
Y[d]	≥1.0	≥1.0	≥1.0	≥1.0	≥1.0	−25%
Design range	2.0–4.0	2.0–4.0	2.0–4.5	2.5–5.5	2.5–6.0	—

(a) If the contract requires a pavement reinforced with two layers of reinforcement, the Engineer will only measure the depth of the top layer of steel.

(b) To determine pavement thicknesses, use the same depth range as the pavement the shoulder is tied to. Use the average shoulder thickness, if tapered.

(c) Pavement or base course.

(d) If a core length measures at least 0.2 inch over the plan thickness, increase the maximum depth range by one-half the excess core length over the plan thickness, round to the nearest 0.1 inch, in accordance with ASTM E29, and then add it to the range shown.

Section 901. Cement and Lime

901.01. General Requirements

Provide facilities for sampling and inspecting cement at the mill, distribution point, and project. Store cement to allow access for inspection and identification of each shipment.

Ensure that Portland cement does not develop false set if tested by the mortar method specified in ASTM C359. The Department defines false set as occurring if penetration is less than 5 mm at 5-, 8-, or 11-minute intervals. The Department will apply these limits if difficulties arise from premature stiffening during the concrete placement or finishing.

Before concrete placement, provide the Engineer a copy of the Certification of Quality of Cement, as provided by the producer.

901.02. Testing

Cement and lime materials testing must be in accordance with the specified ASTM, AASHTO, or Department methods, as modified by this section.

901.03. Portland Cement

A. **Type I, Type II, and Type III Portland Cements.** Type I, Type II, and Type III Portland cements must meet the requirements of ASTM C150/C150M. The requirements for time of setting by Gillmore Needle or Vicat Needle and the 7-day and 28-day compressive strength apply.

B. **Blended Cements.** Blended cements must meet the requirements of ASTM C595/C595M.

901.04. Masonry Cement

Masonry cement must meet the requirements of ASTM C91/C91M, Type N, Type S, or Type M.

901.05. Hydrated Lime

Hydrated lime must meet the requirements of ASTM C207, Type S, or Type SA.

901.06. Slag Cement

Slag cement must meet the requirements of ASTM C989/C989M, Grade 100, minimum.

Temporary lowering of sanitary structure covers, if required, will be measured and paid for as **Dr Structure, Temp Lowering** in accordance with subsection 403.04.E.

Video inspection, mandrel testing, and integrity testing are all considered as included in the contract unit price for sanitary sewer.

Payment to remedy an unsatisfactory test, including removing and replacing any backfill, will be considered as included in the contract unit price for sanitary sewer and sanitary structures.

As-built plans are included in the contract unit price for associated sanitary sewer pay items. Payment may be withheld until the as-built plans are acceptable to the Engineer.

901.07. Fly Ash

Fly ash must meet the requirements of ASTM C618, Class F or Class C, except that the loss on ignition must not exceed 5% and the air-entraining admixture uniformity requirement in ASTM C168, Table 3 of Supplementary Optional Physical Requirements, applies.

901.08. Silica Fume, Dry-Densified

Dry-densified silica fume must meet the requirements of ASTM C1240.

Section 902. Aggregates

902.01. General Requirements

The Department may re-inspect and retest aggregates regardless of inspection at the producing plant. Provide safe access to the material for sampling from haul units or stockpiles.

Do not use spent metal casting foundry sand unless the contract expressly allows for its use.

Do not contaminate aggregate during loading or measurement.

902.02. Testing

Test aggregate materials in accordance with the following:

Material	Test
Wire Cloth and Sieves	AASHTO M92
Materials Finer than 75 mm (No. 200) Sieve in Mineral Aggregates by Washing	AASHTO T11
Specific Gravity and Absorption of Coarse Aggregate	AASHTO T85
Specific Gravity and Absorption of Fine Aggregates	AASHTO T84
Sieve Analysis of Fine and Coarse Aggregate	AASHTO T27
Sampling and Testing Fly Ash	ASTM C311/C311M
Organic Impurities in Fine Aggregate	AASHTO T21
Sieve Analysis of Mineral Filler	AASHTO T37
Mortar Strength	AASHTO T71
Particle Size Analysis	AASHTO T88
Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test	AASHTO T176
Uncompacted Void Content of Fine Aggregate	AASHTO T304
Sand Equivalent of Fine Aggregate	ASTM D2419
Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate	ASTM D4791
Water Asphalt Preferential Test	MTM 101
Los Angeles (LA) Abrasion Resistance of Aggregate	MTM 102
Insoluble Residue in Carbonate Aggregate	MTM 103

Sampling Aggregates ..... MTM 107
Loss by Washing ..... MTM 108
Sieve Analysis of Aggregate ..... MTM 109
Deleterious and Objectionable Particles ..... MTM 110
Aggregate Wear Index ..... MTM 111
Aggregate Wear Index ..... MTM 112
Selection and Preparation of Coarse Aggregate Samples for Freeze-Thaw Testing ..... MTM 113
Making Concrete Specimens for Freeze-Thaw Testing on Concrete Coarse Aggregate ..... MTM 114
Freeze-Thaw Testing of Coarse Aggregate ..... MTM 115
Crushed Particles in Aggregates ..... MTM 117
Angularity Index of Fine Aggregate ..... MTM 118
Sampling Open-Graded Drainage Course Compacted in Place ..... MTM 119
Dry Unit Weight (Loose Measure) of Coarse Aggregate ..... MTM 123
Determining Percentage of Flat Particles, Elongated Particles, or Flat and Elongated Particles in Aggregate ..... MTM 130
Determining Specific Gravity and Absorption of Coarse Aggregates ..... MTM 320
Determining Specific Gravity and Absorption of Fine Aggregates ..... MTM 321

A. **Definitions.** The Department uses the following terminology in the testing and acceptance of aggregates:

Base Fineness Modulus. Average fineness modulus typical of the source for a specific fine aggregate.

Cobblestones (Cobbles). Rock fragments, usually rounded or semi-rounded, with an average dimension between 3 and 10 inches.

Crushed Concrete Aggregate. Crushed Portland cement concrete.

Crushed Particles. Particles with at least one fractured face. The contract will specify the number of fractured faces based on required use. Unless otherwise specified, one fractured face is considered a crushed particle.

Iron Blast Furnace Slag. Synthetic nonmetallic byproduct simultaneously produced with pig iron in a blast furnace that consists primarily of a fused mixture of oxides of silica, alumina, calcium, and magnesia.

Manufactured Fine Aggregate. 100% crushed rock, gravel, iron blast-furnace slag, reverberatory furnace slag, or steel furnace slag.

Natural Aggregates. Aggregates that originated from stone quarries, gravel, sand, or igneous/metamorphic rock deposits.

Natural Sand 2NS and 2MS. Fine, clean, hard, durable, uncoated particles of sand free of clay lumps and soft or flaky granular material resulting from the natural disintegration of rock and used in concrete mixtures, mortar mixtures, and intrusion grout for pre-placed aggregate concrete.

Relative Density (oven dry [OD]). Specific gravity of aggregate that is dried or assumed to be dried. The aggregate is considered dried when it has been maintained at a temperature of 110 ± 5°C for sufficient time to remove all combined water by reaching a constant mass.

Reverberatory Furnace Slag. Nonmetallic byproduct of refined copper ore.

Salvaged Aggregate. Dense-graded aggregate or open-graded aggregate saved or manufactured from Department project sources that may consist of natural aggregate or blast furnace slag with particle sizes no greater than 2 inches and no visible organic or foreign matter.

Slag Aggregates. Byproducts formed in the production of iron, copper, and steel.

Soft Particles. Structurally weak particles or particles experiencing environmental deterioration, including shale, siltstone, friable sandstone, ochre, coal, and clay ironstone.

Steel Furnace Slag. Synthetic byproduct of basic oxygen, electric, or open-hearth steel furnaces that consist primarily of a fused mixture of oxides of calcium, silica, iron, alumina, and magnesia.

Stone Sand 2SS. Sand manufactured from stone sources. The sources must meet the physical requirements for coarse aggregate 6A prior to crushing. Stone sand in concrete base course or structural concrete is allowed only if not exposed to vehicular traffic.

902.03. Coarse Aggregates for Portland Cement Concrete

For coarse aggregates for Portland cement concrete, use Michigan Class 6AAA, 6AA, 6A, 17A, and 26A coarse aggregate produced from natural aggregate, iron blast furnace slag, or reverberatory furnace slag sources.

The Contractor may produce Michigan Class 6A, 17A, and 26A from crushed Portland cement concrete for uses specified in this subsection.

Ensure that the relative density (OD) falls within the limits established by freeze-thaw testing.

Provide coarse aggregates for Portland cement concrete in accordance with Table 902-1, Table 902-2, and this subsection.

A. **Slag Coarse Aggregate.** Use slag coarse aggregate consisting of iron blast furnace slag or reverberatory furnace slag with a dry (loose measure) unit weight of at least 70 pounds per cubic foot in accordance with MTM 123.

B. **Crushed Concrete Coarse Aggregate.** Use Department-owned concrete on the project to produce crushed concrete coarse aggregate. The Contractor may use crushed concrete coarse aggregate in the following concrete mixtures: curb and gutter, valley gutter, sidewalk, concrete barriers, driveways, temporary pavement, interchange ramps with a commercial average daily traffic (ADT) of less than 250, and concrete shoulders.

   Do not use crushed concrete coarse aggregate in the following: mainline pavements or ramps with a commercial ADT greater than or equal to 250, concrete base course, bridges, box or slab culverts, headwalls, retaining walls, pre-stressed concrete, or other heavily reinforced concrete.

   Avoid contamination with non-concrete materials, including joint sealants, hot mix asphalt (HMA) patching, and base layer aggregate or soil, when processing crushed concrete coarse aggregate. Limit contamination particles retained on the ⅜-inch sieve to no greater than 3.0%, based on a particle count of the total retained ⅜-inch aggregate particles. Aggregate stockpile contaminated with building brick, wood, or plaster will be rejected. Steel reinforcement pieces may remain in the stockpile if they can pass the maximum grading sieve size without aid. Ensure that the fine aggregate portion of the gradation does not exceed a liquid limit of 25.0% or a plasticity index of 4.0.

   The Engineer will test the freeze-thaw durability of crushed concrete coarse aggregate for each project. After the Department's central laboratory receives the aggregate samples from the supplier, each test will require at least 3 months.

   Crush concrete ensuring that it maintains uniform aggregate properties with no apparent segregation. The relative density (OD) must not vary more than ±0.05 and absorption by more than ±0.40. Separate crushed concrete aggregate according to the original coarse aggregate type, except in the following situations:

1. If the weighed quantities of each aggregate type retained on the No. 4 sieve do not differ from the average quantities obtained from at least three representative samples by more than 10%; or
2. If using aggregate produced from concrete pavement with only one type of aggregate but repaired with concrete patches with a different aggregate type.

C. **Aggregates for Optimized Gradation**

1. **Coarse Aggregate Requirements**

a. Coarse aggregate includes all aggregate particles greater than or retained on the $^{3}/_{4}$-inch sieve.

b. The physical requirements for the coarse aggregate are as specified in Table 902-1 and as follows:

i. High-performance concrete mixtures – Class 6AAA; and

ii. All other concrete mixtures requiring optimized gradation – Class 6AA.

c. The maximum loss by washing (LBW) per MTM 108 is 2.0% for materials produced entirely by crushing rock, boulders, cobbles, slag or concrete; otherwise 1.0%.

d. The maximum 24-hour soak absorption is 2.50%.

2. **Intermediate Aggregate Requirements**

a. Intermediate aggregate includes all aggregate particles passing the $^{3}/_{4}$-inch sieve through those retained on the No. 4 sieve.

b. The physical requirements for intermediate aggregate are as specified in Table 902-1 for Class 26A.

c. The maximum LBW per MTM 108 is 3.0%.

3. **Fine Aggregate Requirements**

a. Fine aggregate includes all aggregates particles passing the No. 4 sieve.

b. The fine aggregate must meet the requirements of subsection 902.08.

902.04. Chip Seal Aggregates

For single chip seal, use 34CS aggregate with a maximum moisture content in accordance with Table 902-8 and as described in MDOT's *Procedures for*

Aggregate Inspection, calculated in accordance with section 109 at the time of placement, and in accordance with Table 902-7 and Table 902-8.

For double chip seal, use CS-T aggregate with a maximum moisture content in accordance with Table 902-8 and as described in MDOT's *Procedures for Aggregate Inspection*, calculated in accordance with section 109 at the time of placement, and in accordance with Table 902-7 and Table 902-8.

902.05. Dense-Graded Aggregates for Base Course, Surface Course, Shoulders, Approaches, and Patching

When necessary, combine fine aggregate with natural aggregate, iron blast-furnace slag, reverberatory furnace slag, or crushed concrete to produce Michigan Class 21AA, 21A, 22A, 23A, and 23AA dense-graded aggregates in accordance with Table 902-1, Table 902-2, and this subsection.

The use of crushed concrete is prohibited on the project within 100 feet of any water course (stream, river, county drain, etc.) and lake regardless of the application or location of the water course or lake relative to the project limits.

Dense-graded aggregate produced by crushing Portland cement concrete must not contain more than 5.0% building rubble or HMA by particle count. The Department defines building rubble as building brick, wood, plaster, or other material. Pieces of steel reinforcement capable of passing through the maximum grading sieve size without aid are allowed.

Do not use Class 21AA, 21A, or 22A dense-graded aggregate produced by crushing Portland cement concrete to construct an aggregate base or an aggregate separation layer when the dense-graded layer drains into an underdrain unless at least one of the following conditions apply:

A. A vertical layer of at least 12 inches of granular Class I, II, IIA, or IIAA exists between the dense-graded aggregate layer and an underdrain; or

B. A geotextile liner or blocking membrane that will be a barrier to leachate is placed between the crushed concrete and the underdrain.

Produce Class 23A dense-graded aggregate from steel furnace slag for use only as an unbound aggregate surface course or an unbound aggregate shoulder.

902.06. Open-Graded Aggregates for Earthwork, Open-Graded Drainage Courses, and Underdrains

Use Michigan Class 4G, 34G, 34R, and 46G open-graded aggregates produced from natural aggregate, iron blast-furnace slag, or reverberatory furnace slag in accordance with Table 902-1 and Table 902-2. Class 4G may be produced from crushed concrete.

The use of crushed concrete is prohibited on the project within 100 feet of any water course (stream, river, county drain, etc.) and lake regardless of the application or location of the water course or lake relative to the project limits.

Open-graded aggregate 4G produced by crushing Portland cement concrete must not contain more than 5.0% building rubble or HMA by particle count. The Department defines building rubble as building brick, wood, plaster, or other material. Pieces of steel reinforcement capable of passing through the maximum grading sieve size without aid are allowed.

902.07. Granular Materials for Fill and Subbase

Use granular materials consisting of sand, gravel, crushed stone, iron blast-furnace slag, reverberatory furnace slag, or a blend of aggregates in accordance with Table 902-3 and this subsection.

The Contractor may make the following substitutions:

A. Class I, Class IIAA, or Dense-Graded Aggregate 21A, 21AA, or 22A material for Class II material;

B. Class I, Class II, Class IIA, Class IIAA, Class IIIA, or Dense-Graded Aggregate 21A, 21AA, or 22A material for Class III material;

C. Class I material for Class IIAA material; and

D. Dense-Graded Aggregate 21A, 21AA, or 22A material for Class IIA.

Do not use material with cementitious properties or with permeability characteristics that do not meet design parameters for subbase.

Granular material produced from crushed Portland cement concrete is not permitted.

The Engineer may allow the placement of granular material produced from steel furnace slag below the top 3 feet of the embankment and fill.

902.08. Fine Aggregates for Portland Cement Concrete and Mortar

Test for organic impurities in accordance with AASHTO T21. The aggregate must not produce a color darker than Organic Plate No. 3 (Gardener Color Standard No. 11). The Engineer may approve the use of fine aggregate that fails the test for organic impurities based on one of the following:

A. The discoloration resulted from small quantities of coal, lignite, or similar discrete particles, or

B. The tested concrete develops a relative 7-day strength of at least 95% in accordance with AASHTO T71.

Uniformly grade the aggregate from coarse to fine in accordance with Table 902-4. Fine aggregate 2NS, 2SS, and 2MS must meet fineness modulus requirements in Table 902-4.

Do not use crushed Portland cement concrete fine aggregate in concrete mixtures.

902.09. Aggregate General Requirements for HMA Mixtures

Use aggregate materials meeting the requirements of Table 902-5 and Table 902-6 for the HMA mix number and type required, respectively.

A. **Coarse Aggregates.** For HMA mixtures, use natural aggregate, iron blast-furnace slag, reverberatory furnace slag, steel furnace slag, or crushed concrete as coarse aggregate.

B. **Fine Aggregates.** For HMA mixtures, use natural aggregate, iron blast-furnace slag, reverberatory furnace slag, steel furnace slag, manufactured fine aggregate, or a uniformly graded blend as fine aggregate. Fine aggregates must be clean, hard, durable, uncoated, and free of clay lumps, organic matter, soft or flakey material, and other foreign matter.

902.10. Surface Treatment Aggregates

A. **Paver-Placed Surface Seal.** For paver-placed surface seal, use aggregate 27SS or 30SS consisting of material meeting the requirements in subsection 902.09.B and in accordance with Table 902-7 and Table 902-8.

B. **Micro-Surfacing.** For micro surfacing, use 2FA and 3FA aggregates consisting of crushed material from a quarried stone, natural gravel, slag source, or a blend in accordance with Table 902-7 and Table 902-8.

C. **Slurry Seal.** For slurry seal, use 2FA aggregate consisting of crushed material from a quarried stone, natural gravel, slag source, or a blend in accordance with Table 902-7 and Table 902-8.

902.11. Mineral Filler for HMA Mixtures

For HMA mixtures, use dry, 3MF mineral filler consisting of limestone dust, dolomite dust, fly ash collected by an electrostatic precipitation method, slag, or hydrated lime with 100% passing the No. 30 sieve and 75% to 100% passing the No. 200 sieve. Mineral filler must be from a Department-approved source or must be tested on a per-project basis. The free carbon content of the fly ash sample must not exceed 12% by weight as measured by the loss on ignition test in accordance with ASTM C311/C311M.

Table 902-1:
Grading Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open-Graded Aggregates

Material Type	Series/ Class	Item of Work by Section Number (Sequential)	Sieve Analysis (MTM 109) Total % Passing[a]										LBW (MTM 108) % Passing
			2½ inch	2 inch	1½ inch	1 inch	¾ inch	½ inch	⅜ inch	No. 4	No. 8	No. 30	No. 200[a]
Coarse aggregates	6AAA[b]	602, 1004	—	—	100	90–100	60 – 85	30–60	—	0–8	—	—	≤1.0[c]
	6AA[b]	406, 602, 706, 708, 806, 1004, 1006	—	—	100	95–100	—	30–60	—	0–8	—	—	≤1.0[c]
	6A	206, 401, 402, 406, 602, 603, 706, 806, 1004, 1006	—	—	100	95–100	—	30–60	—	0–8	—	—	≤1.0[c]
	17A	401, 406, 706, 708, 1004	—	—	—	100	90–100	50–75	—	0–8	—	—	≤1.0[c]
	25A		—	—	—	—	100	95–100	60–90	5–30	0–12	—	≤3.0
	26A	706, 712, 1004, 1006	—	—	—	—	100	95–100	60–90	5–30	0–12	—	≤3.0
	29A	1004	—	—	—	—	—	100	90–100	10–30	0–10	—	≤3.0
Dense-graded aggregates	21AA	302, 304, 305, 306, 307	—	—	100	85–100	—	50–75	—	—	20–45	—	4–8[d][e]
	21A	302, 305, 306, 307	—	—	100	85–100	—	50–75	—	—	20–45	—	4–8[d][e]
	22A	302, 305, 306, 307	—	—	—	100	90–100	—	65–85	—	30–50	—	4–8[d][e,f]
	23A	306, 307	—	—	—	100	—	—	60–85	—	25–60	—	9–16[e]
	23AA	306, 307	—	—	—	100	—	—	60–85	—	25–60	—	9–16[e]

Table 902-1 (cont.):
Grading Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open-Graded Aggregates

Material Type	Series/ Class	Item of Work by Section Number (Sequential)	Sieve Analysis (MTM 109) Total % Passing[a]										LBW (MTM 108) % Passing
			2½ inch	2 inch	1½ inch	1 inch	¾ inch	½ inch	⅜ inch	No. 4	No. 8	No. 30	No. 200[a]
Open-graded aggregates	4G [g]	303	—	—	100	85–100	—	45–65	—	—	15–30	6–18	≤6.0
	4G [h]	303	—	—	100	85–100	—	45–70	—	—	15–35	8–22	≤8.0
	34R	401, 404, 406	—	—	—	—	—	100	90–100	—	0 – 5	—	≤3.0
	34G	404, 406	—	—	—	—	—	100	95–100	—	0 – 5	—	≤3.0
	46G	206, 208, 401, 402, 406, 916	—	—	100	95-100	—	30-60	—	0-8	—	—	≤3.0

(a) Based on dry weights.

(b) Class 6AAA will be used exclusively for all mainline and ramp concrete pavement when the directional commercial ADT is greater than or equal to 5,000 vehicles per day. Other requirements apply for high-performance concrete.

(c) Loss by washing (LBW) will not exceed 2.0% for material produced entirely by crushing rock, boulders, cobbles, slag, or concrete.

(d) When used for aggregate base courses, surface courses, shoulders, and approaches and the material is produced entirely by crushing rock, boulders, cobbles, slag, or concrete, the maximum limit for LBW must not exceed 10%.

(e) The limits for LBW of dense-graded aggregates are significant to the nearest whole percent.

(f) For aggregates produced from sources in Berrien County, the LBW must not exceed 8% and the sum of LBW, and shale particles must not exceed 10%.

(g) Gradation prior to placement and compaction.

(h) Gradation compacted in-place, sampled from the grade in accordance with MTM 119.

Table 902-2:
Physical Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open-Graded Aggregates[a]

		Gravel, Stone, and Crushed Concrete						Slag[b]		All Aggregates
Material Type	**Series/ Class**	**Crushed Material, % min. (MTM 117)**	**Loss, % max, LA Abrasion (MTM 102)**	**Soft Particles, % max. (MTM 110)**	**Chert, % max. (MTM 110)**	**Sum of Soft Particles and Chert, % max. (MTM 110)**	**Freeze-Thaw Dilation, % per 100 cycle max. (MTM 115)[c]**	**Sum of Coke and Coal Particles, % max. (MTM 110)**	**Freeze-Thaw Dilation, % per 100 cycles max. (MTM 115)[c]**	**Flat and Elongated Particles, ratio % max. (ASTM D4791) (MTM 130)**
Coarse aggregates[d]	6AAA	—	40	2.0[e]	2.5	4.0	0.040[f]	1.0	0.040[f]	3:1–15.0[g]
	6AA[h]	—	40	2.0[e]	—	4.0	0.067[i]	1.0	0.067	—
	6A[h]	—	40	3.0[e]	7.0	9.0	0.067	1.0	0.067	—
	17A[h]	—	40	3.5[e]	8.0	10.0	0.067[i]	1.0	0.067	—
	25A	95	45	8.0[j]	—	8.0	—	1.0	—	3:1–20.0[k]
	26A[h]	—	40	2.0[e]	—	4.0	0.067	1.0	0.067	—
	29A	95	45	8.0[j]	—	8.0	—	1.0	—	3:1–20.0[k]
Dense-graded aggregates[l]	21AA	95	50	—				—		—
	21A	25	50	—				—		—
	22A	25	50	—				—		—
	23A	25	50	—				—		—
	23AA	95	50	—				—		—

Table 902-2 (cont.):
Physical Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open-Graded Aggregates[a]

		Gravel, Stone, and Crushed Concrete						Slag[b]		All Aggregates
Material Type	Series/ Class	Crushed Material, % min. (MTM 117)	Loss, % max, LA Abrasion (MTM 102)	Soft Particles, % max. (MTM 110)	Chert, % max. (MTM 110)	Sum of Soft Particles and Chert, % max. (MTM 110)	Freeze-Thaw Dilation, % per 100 cycle max. (MTM 115)[c]	Sum of Coke and Coal Particles, % max. (MTM 110)	Freeze-Thaw Dilation, % per 100 cycles max. (MTM 115)[c]	Flat and Elongated Particles, ratio % max. (ASTM D4791) (MTM 130)
Open-graded aggregates	4G	95	45[m]	—				—		—
	34R	≤20	45[m]	—				—		—
	34G	100	45[m]	—				—		—
	46G	95	45[m]	—				—		—

Table 902-2 (cont.):
Physical Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open-Graded Aggregates[(a)]

(a) See subsections 902.03.B, 902.05, and 902.06 for additional physical requirements for coarse aggregate, dense-graded aggregates, and open-graded aggregates, respectively.

(b) Iron blast furnace and reverberatory furnace slag must contain no free (unhydrated) lime.

(c) If the relative density (OD) is >0.04 less than the relative density (OD) of the most recently tested freeze-thaw sample, the aggregate will be considered to have changed characteristics and be required to have a new freeze-thaw test per MTM 113 conducted prior to use on Department projects.

(d) Grade 3500 concrete requires an optimized aggregate gradation as specified in section 604. Use aggregates only from geologically natural sources.

(e) Clay-ironstone particles must not exceed 1.0% for 6AAA, 6AA, and 26A, and 2.0% for 6A and 17A. Clay-ironstone particles are also included in the percentage of soft particles for these aggregates.

(f) Maximum freeze-thaw dilation is 0.067 when the directional commercial ADT is less than 5,000 vehicles per day. Maximum dilation is 0.040 for all high-performance concrete.

(g) ASTM D4791 Section 8.4 will be followed. The test will be performed on the material retained down to and including the 3/8-inch sieve.

(h) Except for pre-stressed beams, the sum of soft and chert particles may be up to 3.0% higher than the values determined from the sample tested for freeze-thaw durability. However, under no circumstances will the deleterious particle percentages exceed the specification limits in Table 902-2. In addition, a source may be restricted to a minimum percent crushed not to exceed 15% less than the percent crushed in the freeze-thaw sample. When the freeze-thaw dilation is between 0.040 and 0.067% per 100 cycles, more restrictive limits will be applied.

(i) Maximum dilation of 0.010 for pre-stressed concrete beams.

(j) Friable sandstone is included in the soft particle determination for chip seal aggregates.

(k) ASTM D4791 Section 8.4 will be followed. The test will be performed on the material retained down to and including the No. 4 sieve.

(l) Quarried carbonate (limestone or dolomite) aggregate may not contain over 10% insoluble residue finer than No. 200 sieve when tested in accordance with MTM 103.

(m) If a blend of different aggregate sources, the abrasion value applies to each source.

Table 902-3:
Grading Requirements for Granular Materials

Material	Sieve Analysis (MTM 109), Total % Passing[a]									LBW % Passing No. 200[a][b]
	6 inch	3 inch	2 inch	1 inch	½ inch	⅜ inch	No. 4	No. 30	No. 100	
Class I	—	—	100	—	45–85	—	20–85	5–30	—	0–5
Class II[c]	—	100	—	60–100	—	—	50–100	—	0–30	0–7
Class IIA[c]	—	100	—	60–100	—	—	50–100	—	0–35	0–10
Class IIAA	—	100	—	60–100	—	—	50–100	—	0–20	0–5
Class III	100	95–100	—	—	—	—	50–100	—	—	0–15
Class IIIA	—	—	—	—	—	100	50–100	—	0–30	0–15

(a) Test results based on dry weights.

(b) Use test method MTM 108 for LBW.

(c) Except for use in granular blankets, Class IIA granular material may be substituted for Class II granular material for projects in the following counties: Arenac, Bay, Genesee, Gladwin, Huron, Lapeer, Macomb, Midland, Monroe, Oakland, Saginaw, Sanilac, Shiawassee, St. Clair, Tuscola, and Wayne.

Table 902-4:
Grading Requirements for Fine Aggregates

Material	Sieve Analysis (MTM 109), Total % Passing[a]							LBW % Passing No. 200[a][b]	Fineness Modulus Variation[c]
	⅜ inch	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100		
2NS	100	95–100	65–95	35–75	20–55	10–30	0–10	0–3.0	±0.20[d]
2SS[e]	100	95–100	65–95	35–75	20–55	10–30	0–10	0–4.0	±0.20[d]
2MS	—	100	95–100	—	—	15–40	0–10	0–3.0	±0.20[d]

(a) Test results based on dry weights.

(b) Use test method MTM 108 for LBW.

(c) Aggregate having a fineness modulus differing from the base fineness modulus of the source by the amount exceeding the maximum variation specified in the table will be rejected. Use ASTM C136.

(d) The base fineness modulus will be supplied by the aggregate producer at the start of each construction season and be from 2.50 to 3.35. The base fineness modulus, including the permissible variation, will be from 2.50 to 3.35.

(e) Quarried carbonate (limestone or dolomite) cannot be used for any application subject to vehicular traffic.

Table 902-5:
Superpave Final Aggregate Blend Gradation Requirements

Standard Sieve	Mix Number				
	5	4	3 Leveling Course	3 Base Course	2
	% Passing Criteria (Control Points)				
1½ inch	—	—	—	—	100
1 inch	—	—	100	100	90–100
3/4 inch	—	100	90–100	90–100	≤90
1/2 inch	100	90–100	≤90	≤90	—
3/8 inch	90–100	≤90	—	—	—
No. 4	≤90	—	—	—	—
No. 8	47–67	39–58	35–52	23–52	19–45
No. 16	—	—	—	—	—
No. 30	—	—	—	—	—
No. 50	—	—	—	—	—
No. 100	—	—	—	—	—
No. 200	2.0–10.0	2.0–10.0	2.0–8.0	2.0–8.0	1.0–7.0

Table 902-6:
Superpave Final Aggregate Blend Physical Requirements

Est. Traffic (million ESAL)	Mix Type	Minimum Criteria						Maximum Criteria					
		% Crushed[a]		Fine Aggregate Angularity		% Sand Equivalent		LA Abrasion % Loss[b]		% Soft Particles[c]		% Flat and Elongated Particles[d]	
		Course(s)						Course(s)					
		Top and Leveling	Base	Top and Leveling	Base	Top and Leveling	Base	Top and Leveling	Base	Top and Leveling	Base	Top and Leveling	Base
<0.3	EL	55 / —	—	—	—	40	40	45	45	10	10	—	—
≥0.3 – <3	EML	75 / —	50 / —	43	40	40	40	35	40	5	5	10	10
≥3 – <30	EMH	90 / 85	80 / 75	45	40	45	45	35	35	3	4.5	10	10
≥30 – <100	EH	100 / 100	95 / 90	45	45	50	50	35	35	3	4.5	10	10

ESAL = equivalent single-axle load

(a) XX / YY denotes that XX% of the coarse aggregate has one fractured face and YY% has at least two fractured faces.

(b) If a blend of different aggregate sources, the abrasion value applies to each source.

(c) Soft particles maximum is the sum of the shale, siltstone, ochre, coal, clay-ironstone, and particles that are structurally weak or non-durable in service.

(d) Maximum by mass with a 1:5 aspect ratio.

Table 902-7:
Capital Preventive Maintenance Final Aggregate Blend Gradation Requirements

	Mechanical Analysis, Total % Passing										
Material	**¾ inch**	**½ inch**	**⅜ inch**	**¼ inch**	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200[a]**
27SS	100	85–100	55–80	—	22–38	19–32	15–24	11–18	8–14	5–10	4–7[b]
30SS	—	100	85–100	—	22–38	19–32	15–24	11–18	8–14	5–10	4–7[b]
34CS[c]	100	100	90–100	—	0–15	0–5	—	—	—	—	≤2
CS-T[c]	100	100	100	85–100	—	0–15	—	—	—	—	≤2
2FA	—	—	100	—	90–100	65–90	45–70	30–50	18–30	10–21	5–15[b]
3FA	—	—	100	—	70–90	45–70	28–50	19–34	12–25	7–18	5–15[b]

(a) Includes mineral filler.
(b) No. 200 limits are significant to the nearest whole percent.
(c) All aggregate must be washed.

Table 902-8:
Capital Preventive Maintenance Aggregate Blend Physical Requirements

Material		% Crushed (Min.) MTM 117[k]	Angularity Index (Min.) MTM 118	Uncompacted Void (Min.) AASHTO T304	LA Abrasion (% Loss Max.) MTM 102[f]	Aggregate Wear Index (AWI) (Min.) MTM 111, 112[h]	Soft Particles (% Max.) MTM 110	Sand Equivalent (% Min.) AASHTO T176	Flat, Elongated, or Flat and Elongated (% Max.) ASTM D4791	Absorp. (% Max.) AASHTO T85	Micro-Deval (% Loss Max.) AASHTO T327
27SS[e]		100 / 90	—	40	35	260	5.0[a]	45	25.0[b]	3.0	18
30SS[e]		100 / 90	—	40	35	260	5.0[a]	45	25.0[b]	3.0	18
34CS[j]	ADT ≥ 4,000	100 / 90	—	—	35[g]	260[i]	3.5[a]	—	15.0[b]	—	—
	ADT < 4,000	95 / 85	—	—	35[g]	220	3.5[a]	—	15.0[b]	—	—
CS-T[j]	ADT ≥ 4,000	100 / 90	—	—	35[g]	260[i]	3.5[a]	—	—	—	—
	ADT < 4,000	95 / 85	—	—	35[g]	220	3.5[a]	—	—	—	—
2FA		—	4.0[c]	—	45	260	—	60[d]	—	—	—
3FA		—	4.0	—	45	260	—	60	—	—	—

(a) Sum of shale, siltstone, clay-ironstone, and structurally weak.

(b) For material retained on the No. 4 sieve and above, ensure that the ratio between length to width, width to thickness, and length to thickness is no greater than 3:1.

(c) Angularity Index must exceed 2.0 for at least 50% of the blending sands for slurry seal applications.

(d) Does not apply to slurry seals.

(e) Must be 100% virgin aggregate.

(f) If a blend of different aggregate sources, the abrasion value applies to each source.

(g) Natural aggregate. LA abrasion maximum loss of 45% for iron blast-furnace slag aggregate.

(h) Does not apply to a shoulder chip seal or interlayer application.

(i) Single-chip seals. For double-chip seals, a 260 min. AWI of a 60/40 weighted average in which the top course will be weighted at 60% and base course will be weighted at 40% with the higher AWI aggregate as the top course.

(j) Moisture content at time of placement ≤4%.

(k) XX / YY denotes that XX% of the coarse aggregate has one fractured face and YY% has at least two fractured faces.

Section 903. Admixtures and Curing Materials for Concrete

903.01. Air-Entraining Admixtures

Select liquid air-entraining admixtures for Portland cement concrete from the Qualified Products List.

903.02. Liquid Chemical Admixtures

Select liquid chemical admixtures for use in Portland cement concrete from the Qualified Products List. Liquid chemical admixtures must not contain a chloride ion content greater than 0.5% by weight.

The Department uses the following ASTM C494/C494M terms for chemical admixtures:

Table 903-1:
ASTM C494/C494M Terms for Chemical Admixtures

Type	Term
A	Water-reducing admixtures
C	Accelerating admixtures
D	Water-reducing and -retarding admixtures
E	Water-reducing and -accelerating admixtures
F	Water-reducing, high-range admixtures
G	Water-reducing, high-range, and -retarding admixtures

The Department refers to water-reducing and mid-range admixtures not included in ASTM C494/C494M as Type MR.

903.03. Latex Admixtures

Formulated latex admixture for modifying mortar or concrete mixtures must be a non-toxic, film forming, polymeric emulsion to which all stabilizers are added at the point of manufacture. Latex admixtures must be homogeneous and uniform in composition.

A. **Physical Properties.** White latex styrene butadiene modifier must have between 46.0 and 49.0% solids; pH, as shipped, between 8.5 and 11.0; and a shelf life of at least 2 years.

B. **Storage.** Protect latex admixtures from freezing. Do not expose latex admixtures to temperatures greater than 85°F for more than 10 days.

903.04. Calcium Chloride Concrete Accelerators

Do not use calcium chloride in prestressed concrete, superstructure concrete, concrete for bridge railings, or concrete containing galvanized steel or aluminum.

Flake or pellet calcium chloride for on-the-job preparation of admixture solutions must meet the requirements of ASTM D98 for 77% grade or 94% grade. Determine the percentage of calcium and magnesium chlorides in accordance with ASTM D345. Provide flake or pellet Type S (solid) material.

Calcium chloride admixture, delivered to the job in solution, must conform to the following chemical composition:

A. From 32.0 to 35.0% calcium chloride ($CaCl_2$) anhydrous;

B. No greater than 1.0% total magnesium as $MgCl_2$;

C. No greater than 2.0% total alkali chlorides calculated as NaCl; and

D. No greater than 0.5% other impurities.

903.05. Polypropylene Fibers

Use 100% virgin polypropylene fibers, ¾ inch long, that meet the requirements of ASTM C1116/C1116M, Type III.

903.06. Concrete Curing Materials for Pavements

A. **White Membrane Curing Compound.** White membrane curing compound must meet the requirements of ASTM C309, Type 2, and be packaged in clean containers.

   Before use and before transferring the compound between containers, agitate the compound to a uniform consistency and ensure that pigment is uniformly suspended.

B. **Transparent Membrane Curing Compound for Base Course.** Transparent membrane curing compound must meet the requirements of ASTM C309, Type 1-D, Class B with fugitive dye.

903.07. Concrete Curing Materials for Structures

A. **White Membrane Curing Compound for Bridge Decks.** Provide white-pigmented, modified, linseed-oil-based material that is either water soluble or an emulsion type that meets the requirements of ASTM C309, Type 2, except that the reflectance requirement and drying time do not apply. Compound must be packaged in clean containers.

Before transferring the compound between containers and applying, agitate the compound to a uniform consistency and ensure uniform suspension of the pigment.

B. **Transparent Membrane Curing Compound.** Transparent membrane curing compound must meet the requirements of ASTM C309, Type 1-D, Class B, with fugitive dye.

C. **Insulating Blankets.** Insulating blankets must have vapor-retarding liners that completely enclose the insulating mat, are bonded to both sides of the insulating mat, and have one reflective face. Blankets must have thicknesses or R-values meeting the requirements of Table 706-1.

Insulating blanket must have a thermal conductivity (k) no greater than 0.27 BTU per hour per square foot temperature gradient of 1°F per inch of thickness at a mean temperature of 75°F when tested in accordance with ASTM C177.

D. **Polystyrene Insulation.** Expanded polystyrene must be cut from preformed material with an average cell diameter no greater than 0.04 inch and as specified in Table 903-2:

Table 903-2:
Polystryene Insulation Specifications

Property	Specification	Test Method
Density	≥0.90 lb/ft³	ASTM C303
Compressive strength	≥9.0 psi	ASTM D1621
Flexural strength	≥25.0 psi	ASTM C203
Water absorption	≤2.0% by volume	ASTM C272/C272M
Thermal conductivity	≤0.27 BTU/hr/ft²[(a)]	ASTM C177

(a) For a temperature gradient of 1°F per inch of thickness at a mean temperature of 75°F

Section 904. Asphaltic Materials

904.01. General Requirements

The certification program described in MDOT's *Materials Quality Assurance Procedures Manual* governs the asphalt binders in Table 904-1 and the emulsified asphalts in Table 904-4, Table 904-5, and Table 904-6. The Contractor may use materials listed in Table 904-2 through Table 904-7 on MDOT projects if tested and approved for use in accordance with MDOT procedures.

The Engineer will notify the Contractor and the supplier to correct materials if test results for the requirements from Table 904-2, Table 904-3, Table 904-4, Table 904-5, Table 904-6, and Table 904-7 deviate from the specified range.

Asphaltic materials testing will be in accordance with the specified ASTM, AASHTO, or Department methods, as modified by this section.

904.02. Application Temperatures

Apply asphaltic materials at temperatures specified in Table 904-7.

904.03. Specific Requirements

A. **Asphalt Binder.** Asphalt binder must be homogeneous and water-free and must not foam when heated to the maximum temperature specified in Table 904-7 for the material required.

If using an anti-foaming agent, use a dimethyl polysiloxane type silicone material, preferably 1000 centistoke viscosity grade unless otherwise approved by the Engineer. Do not add amounts greater than 5 parts per million unless approved by the Engineer. Mechanically mix the asphalt binder after adding anti-foaming agent while in storage at the asphalt plant.

Asphalt binder must be prepared by refining crude petroleum with or without the addition of modifiers. Asphalt binder prepared with reclaimed engine-oil-based products is prohibited.

Organic, virgin, or recycled modifiers that are dissolved, dispersed, or reacted in asphalt cement to enhance performance are allowed.

Asphalt binder must be at least 99.0% soluble in accordance with AASHTO T44 or ASTM D2042.

This specification (subsection 904.03.A) is not applicable for asphalt binders in which fibers or other discrete particles are larger than 250 micrometers.

B. **Cutback Asphalt.** Cutback asphalt must meet the requirements of Table 904-3 and this subsection.

Liquid asphalt must be homogeneous, must not foam when heated to the maximum required temperature, and must be water free unless otherwise required.

Caution: Use caution when heating cutback asphalt, especially rapid-curing (RC) and medium-curing (MC) asphaltic products containing naphtha and kerosene cutback asphalt since the temperatures for use are near or above the flash points. If using heated cutbacks, keep open flames away from pugmill enclosures, tank car domes, distributor tank openings, and storage tank openings.

C. **Emulsified Asphalt.** Emulsified asphalt must meet the requirements of Table 904-4, Table 904-5, Table 904-6, or Table 904-7 and be made from asphalt having a negative spot test result using 35% xylene / 65% heptane solvent, aniline number: 30°C ± 2°C, AASHTO T102. It must be homogeneous and show no separation of asphalt after thorough mixing for a period of at least 30 days after delivery.

Table 904-1:
Performance-Graded Asphalt Binder Specification (PG 46, PG 52, and PG 58)

	PG 46			PG 52							PG 58				
Specification	**−34**	**−40**	**−46**	**−10**	**−16**	**−22**	**−28**	**−34**	**−40**	**−46**	**−16**	**−22**	**−28**	**−34**	**−40**
Pavement Design Temperature															
Avg 7-day max. pavement design temp, °C[(a)]	46			52							58				
Minimum pavement design temp, °C[(a)]	−34	−40	−46	−10	−16	−22	−28	−34	−40	−46	−16	−22	−28	−34	−40
Original Binder															
Flash Point Temp, T48/D 92: Min.	230°C			230°C							230°C				
Viscosity, T316/D4402: Max. 3 Pa•s, Test Temp[(b)]	135°C			135°C							135°C				
Dynamic Shear, T315/D7175: G*/sin θ, Min. 1.00 kPa test temp at 10 rad/s[(c),(d)]	46°C			52°C							58°C				
Rolling Thin Film Oven (T240/D2872)															
Mass loss, max.	1.00%			1.00%							1.00%				
Dynamic Shear, T315/D7175: G*/sin θ, Min. 2.20 kPa test temp at 10 rad/s[(d)]	46°C			52°C							58°C				
Pressure Aging Vessel (PAV) Residue (R28/D6521)															
PAV aging temp[(e)]	90°C			90°C							100°C				
Dynamic shear, T315/D7175: G*sin θ, max. 5000 kPa test temp at 10 rad/s, °C[(d)]	10	7	4	25	22	19	16	13	10	7	25	22	19	16	13
Physical hardening[(f)]	Report			Report							Report				
Creep stiffness, T313/D6648: S, max. 300 MPa, m-value, min. 0.300 test temp at 60 s, °C	−24	−30	−36	0	−6	−12	−18	−24	−30	−36	−6	−12	−18	−24	−30

Table 904-1 (cont.):
Performance-Graded Asphalt Binder Specification (PG 46, PG 52, and PG 58)

(a) Pavement temperatures may be estimated from air temperatures using an algorithm contained in the Long-Term Pavement Performance (LTPP) Bind program, may be provided by the specifying agency, or may be estimated by following the procedures in AASHTO M 323 and R-35.

(b) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.

(c) For quality control (QC) of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be used or supplement dynamic shear measurements of $G^*/\sin\theta$ at test temperatures where the asphalt is a Newtonian fluid. The Contractor may use a standard means of viscosity measurement, including capillary (T201/D2170 or T202/D2171) or rotational viscometer (T316/D4402).

(d) $G^*/\sin\theta$ = high temperature stiffness and $G^*\sin\theta$ = intermediate temperature stiffness.

(e) The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures: 90°C, 100°C, or 110°C. The PAV aging temperature is 100°C for PG 58- and above, except in desert climates, where it is 110°C.

(f) Physical hardening – T313/D6648 is performed on a set of asphalt beams according to ASTM D6648, Section 13.1, except that the conditioning time is extended to 24 hours ±10 minutes at 10°C above the minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.

Table 904-2:
Performance-Graded Asphalt Binder Specification (PG 64 and PG 70)

	PG 64						PG 70					
Specification	**−10**	**−16**	**−22**	**−28**	**−34**	**−40**	**>−10**	**−16**	**−22**	**−28**	**−34**	**−40**
Pavement Design Temperature												
Avg 7-day max. pave design temp[a]	64°C						70°C					
Minimum pavement design temp, °C[a]	−10	−16	−22	−28	−34	−40	−10	−16	−22	−28	−34	−40
Original Binder												
Flash point temp, T48/D92: min.	230°C						230°C					
Viscosity, T316/D4402: max. 3 Pa•s, test temp[b]	135°C						135°C					
Dynamic shear, T315/D7175: G*/sin θ, min. 1.00 kPa test temp at 10 rad/s[c],[d]	64°C						70°C					
Rolling Thin Film Oven (T240/D2872)												
Mass loss, max.	1.00%						1.00%					
Dynamic shear, T315/D7175: G*/sin θ, min. 2.20 kPa test temp at 10 rad/s[d]	64°C						70°C					
Pressure Aging Vessel Residue (R28/D6521)												
PAV aging temp, °C[e]	100						100 (110)					
Dynamic shear, T315/D7175: G*sin θ, max. 5000 kPa test temp at 10 rad/s, °C[d]	31	28	25	22	19	16	34	31	28	25	22	19
Physical hardening[f]	Report						Report					
Creep stiffness, T313/D6648: S, max. 300 MPa, m-value, min. 0.300 test temp at 60 s, °C	0	−6	−12	−18	−24	−30	0	−6	−12	−18	−24	−30

Table 904-2 (cont.):
Performance-Graded Asphalt Binder Specification (PG 64 and PG 70)

(a) Pavement temperatures may be estimated from air temperatures using an algorithm contained in the Long-Term Pavement Performance (LTPP) Bind program, may be provided by the specifying agency, or may be estimated by following the procedures in AASHTO M 323 and R-35.

(b) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.

(c) For QC of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be used or supplement dynamic shear measurements of G*/sin θ at test temperatures where the asphalt is a Newtonian fluid. The Contractor may use a standard means of viscosity measurement, including capillary (T201/D2170 or T202/D2171) or rotational viscometer (T316/D4402).

(d) G*/sin θ = high temperature stiffness and G*sin θ = intermediate temperature stiffness.

(e) The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures 90°C, 100°C or 110°C. The PAV aging temperature is 100°C for PG 58 and above, except in desert climates, where it is 110°C.

(f) Physical hardening – T313/D6648 is performed on a set of asphalt beams according to ASTM D6648, Section 13.1, except that the conditioning time is extended to 24 hours ±10 minutes at 10°C above the minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.

Table 904-3:
Performance Graded Asphalt Binder Specification (PG 76 and PG 82)

	PG 76					PG 82				
Specification	**−10**	**−16**	**−22**	**−28**	**−34**	**−10**	**−16**	**−22**	**−28**	**−34**
Pavement Design Temperature										
Avg 7-day max. pave design temp[a]	76°C					82°C				
Minimum pavement design temp, °C[a]	−10	−16	−22	−28	−34	−10	−16	−22	−28	−34
Original Binder										
Flash point temp, T48/D92: min.	230°C					230°C				
Viscosity, T316/D 4402: max. 3 Pa•s, test temp[b]	135°C					135°C				
Dynamic shear, T315/D7175: G*/sin θ, min. 1.00 kPa test temp at 10 rad/s[c],[d]	76°C					82°C				
Rolling Thin Film Oven (T240/D2872)										
Mass loss, max. percent	1.00					1.00				
Dynamic shear, T315/D7175: G*/sin θ, min. 2.20 kPa test temp at 10 rad/s[d]	76°C					82°C				
Pressure Aging Vessel Residue (R28/D6521)										
PAV aging temp, °C[e]	100 (110)					100 (110)				
Dynamic shear, T315/D7175: G*sin θ, max. 5000 kPa test temp at 10 rad/s, °C[d]	37	34	31	28	22	40	37	34	31	28
Physical hardening[f]	Report					Report				
Creep stiffness, T313/D6648: S, max. 300 MPa, m-value, min. 0.300 test temp at 60 s, °C	0	−6	−12	−18	−24	0	−6	−12	−18	−24

Table 904-3 (cont.):
Performance Graded Asphalt Binder Specification (PG 76 and PG 82)

(a) Pavement temperatures may be estimated from air temperatures using an algorithm contained in the Long-Term Pavement Performance (LTPP) Bind program, may be provided by the specifying agency, or may be estimated by following the procedures in AASHTO M 323 and R-35.

(b) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.

(c) For QC of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be used or supplement dynamic shear measurements of $G^*/\sin\theta$ at test temperatures where the asphalt is a Newtonian fluid. The Contractor may use a standard means of viscosity measurement, including capillary (T201/D2170 or T202/D2171) or rotational viscometer (T316/D4402).

(d) $G^*/\sin\theta$ = high temperature stiffness and $G^*\sin\theta$ = intermediate temperature stiffness

(e) The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures 90°C, 100°C or 110°C. The PAV aging temperature is 100°C for PG 58 and above, except in desert climates, where it is 110°C.

(f) Physical hardening – T313/D6648 is performed on a set of asphalt beams according to ASTM D6648, Section 13.1, except that the conditioning time is extended to 24 hours ±10 minutes at 10°C above the minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.

Table 904-4:
Medium and Rapid Curing Cutback Asphalts

	Requirements			
Test	**MC-30[a]**	**MC-70[a]**	**MC-250**	**RC-250**
Kinematic viscosity, 60°C, mm²/s, T201/D2170	30–60	70–140	250–500	250–500
Flash point, °C:				
Tag open cup, min., T 79	37.8	37.8	—	26.7
Cleveland open cup, min., T 48/D 92	—	—	65.6	—
Distillation test, T78/D402:				
Distillate, % by vol of total distillate to 360°C				
To 225°C	≤25	≤20	≤10 max.	≥35
To 260°C	40–70	20–60	15–55	≥60
To 315.5°C	75–93	65–90	60–87	≥80
Residue from distillation to 360°C, min.	50	55	67	65
Tests on residue from distillation, T78/D402:				
Penetration at 25°C, 100 g, 5 sec, T 49/D 5	120–250	120–250	120–250	80–120
Ductility at 25°C, cm, min., T51/D113[b]	100	100	100	100
Solubility in trichloroethylene, %, min., T44/D2042	99.5	99.5	99.5	99.5
Spot test, AASHTO T102[c]	Neg.	Neg.	Neg.	Neg.
Section number reference	—	914	—	710, 914

(a) Use MC-70 grade from June 1 to September 1 and MC-30 grade other times of the year, unless otherwise directed by the Engineer.

(b) If penetration of residue exceeds 200 and ductility at 25°C is less than 100, the Engineer will accept the material if ductility at 15.6°C exceeds 100.

(c) Use 35% xylene, 65% heptane solvent, aniline number: 30°C ± 2°C.

Table 904-5:
Anionic Emulsified Asphalts

Test	Anionic Emulsified Asphalt Requirements								
	RS-1m	**RS-2a**	**HFRS-2**	**MS-Op**	**MS-2h**	**MS-2s**	**SS-1h**	**LTBC-1**	**LTBC-2**
Viscosity, Saybolt Furol, T59/D7496									
At 25°C, sec	20–100	—	—	—	—	—	20–100	15–100	15–100
At 50°C, sec	—	50–300	50–300	15–150	50–300	50–300	—	—	—
Storage stability test, T59/D6930, 24-hour, % difference max.	2	2	2	3	3	3	2	1	—
Settlement and storage stability test, T59/D6930, 5-day, % difference max.	—	—	—	—	—	—	—	5	5
Demulsibility, T59/S6936:									
35 ml 0.02 N CaCl2, %	20–60	≥60	≥40	—	—	—	—	—	—
50 ml 0.1 N CaC12, %	—	—	—	—	—	—	≤2	—	—
50 ml 0.02 N CaCl2, %	—	—	—	—	—	—	—	—	—
Sieve Test, T59/D6933, % max.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.30	0.30
Miscibility with water, D244[(a)]	—	—	—	—	—	—	Yes	—	—
Distillation to 260°C, T59/D6997, % by weight:									
Residue, min.	65	65	65	65	65	65	60	50	50
Oil distillate, max.	2	2	2	25	7	7	2	1	1
Tests on distillation residue:									
Penetration, 25°C, 100 g, 5 sec, dmm, T49/D5	100–200	100–200	100–200	[(b)]	150–300	≥300	40–90	≤20	≤40

Table 904-5 (cont.):
Anionic Emulsified Asphalts

Test	Anionic Emulsified Asphalt Requirements								
	RS-1m	**RS-2a**	**HFRS-2**	**MS-Op**	**MS-2h**	**MS-2s**	**SS-1h**	**LTBC-1**	**LTBC-2**
Float test, sec, T50/D139									
At 50°C, max.	—	—	—	200	—	—	—	—	—
At 60°C, min.	—	—	1200	—	1200	1200	—	—	—
Ductility, 25°C, cm, min., T51/D113	60	60	60	40[(b)]	—	—	40	—	—
Solubility in trichloroethylene, % min., T44/D2042	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5
Ash content, %, max., D128	2	2	2	2	2	2	2	—	—
Specific gravity, 25/25°C, min., T 228/D 70	0.996	0.996	0.996	—	—	—	—	—	—
Toughness/tenacity, 25°C, 50 cm/min., Nm, min., D 5801	—	—	—	—	—	—	—	—	—
Elastic recovery, 10°C, % min., T 301/D 6084	—	—	—	—	—	—	—	—	—
Softening point, ring and ball, °C, min., T53/D36	—	—	—	—	—	—	—	60	—
Section number reference	—	401	—	501	—	501	501, 805	501, 805	501, 805

(a) No appreciable coagulation or visible separation in 2 hours.

(b) Heat the distillation residue (ASTM D243/D243M) to 100±15 penetration within 2 hours and have a ductility of at least 40 cm.

Nm = Newton meter

Table 904-6:
Cationic Emulsified Asphalts

Test	Cationic Emulsified Asphalts Requirements			
	CRS-1	CRS-2	CMS-2	CSS-1h
Viscosity, Saybolt Furol, T59/D7496:				
At 25°C, sec	—	—	—	20–100
At 50°C, sec	20–100	100–400	50–450	—
Storage stability tests, T59/D6930 04, 24 hr, % difference, max.	1	1	1	1
Demulsibility, %, 35 ml 0.8% dioctyl sodium sulfosuccinate, min., T 59/D 6936[(a)]	40	40	—	—
Particle charge tests, T59/D7402[(b)]	Positive	Positive	Positive	Positive
Sieve tests, T59/D6933, % max. (distilled water)	0.10	0.10	0.10	0.10
Distillation to 260°C, T59/D6997, % by weight	—	—	—	—
Residue, min.	60	65	65	60
Oil distillate, max.	3	3	12	—
Tests on distillation residue:				
Penetration, 25°C, 100 g, 5 sec, dmm, T49/D5	100–250	100–250	100–250	40–90
Ductility, 25°C, 5 cm/min, cm, min., T51/D113	40	40	40	40
Ductility, 4°C, 5 cm/min, cm, T51/D113	—	—	—	—
Elastic/recovery, 4°C,% min., T301/D6084	—	—	—	—
Solubility in trichloroethylene, % min., T44/D2042	97.5	97.5	97.5	97.5
Ash content, % max., D128	2	2	2	2
Specific gravity, 25/25°C, min., T228/D70	0.996	0.996	—	—

Table 904-6 (cont.):
Cationic Emulsified Asphalts

Test	Cationic Emulsified Asphalts Requirements			
	CRS-1	CRS-2	CMS-2	CSS-1h
Toughness/tenacity, 25°C, 50 cm/min., Nm, min., D5801	—	—	—	—
Elastic recovery, 10°C, % min., T301/D6084	—	—	—	—
Cement mixing test, T59/D6935, % max.	—	—	—	2.0
Coating ability and water resistance:				
Coating dry aggregate	—	—	Good	—
Coating after spraying	—	—	Good	—
Coating wet aggregate	—	—	Fair	—
Coating after spraying	—	—	Fair	—
Section number reference	—	—	501	501, 805

(a) The demulsibility test must be made within 30 days from date of shipment.

(b) If particle charge test is inconclusive, material having a maximum pH of 6.7 is acceptable.

Table 904-7:
Capital Preventive Maintenance Emulsions[a]

Test	Capital Preventive Maintenance Emulsion Requirements					
	HFRS-2M	**CRS-2M**	**CSS-1mM**	**CSS-1hM**	**PPSS**	**CSEA**
Viscosity, Saybolt Furol, T59/D7496:						
At 25°C, sec	—	—	20–100	20–100	20–100	—
At 50°C, sec	75–300	75–300	—	—	—	75–400
Storage stability test, T59/D6930, 24-hour, % difference max.	1	1	1	1	1[b]	1
Demulsibility, T59/D6936:						
35 ml 0.8% dioctyl sodium sulfosuccinate, % min.[c]	—	50	—	—	60	50
35 ml 0.02 N $CaCl_2$, %, min.	—	—	—	—	60	—
50 ml 0.1 N $CaC1_2$, %	—	—	—	—	—	—
50 ml 0.02 N $CaCl_2$, %	≥50	—	—	—	—	—
Particle charge tests, T59/D7402[d]		Positive	Positive	Positive	—	Positive
Sieve test, T59/ D6933, % max.	0.10	0.10	0.10	0.10	0.05	0.10
Miscibility with water, D244[e]	—	—	—	—	—	—
Distillation to 260°C, T59/D6997, % by weight:	[f]	[f],[g]	[f]	[f]	[f]	[g]
Residue, min.	65	65	62	62	63	68
Oil distillate, ml, max., D244	2	3	—	—	2	3.0
Tests on distillation residue:						
Penetration, 25°C, 100 g, 5 sec, dmm, T49/D5	80–150	80–150	70–90	40–90	80–150	70–100
Ductility, 25°C, 5 cm/min, cm, T51/D113	—	—	40	40	—	40

Table 904-7 (cont.):
Capital Preventive Maintenance Emulsions[a]

Test	Capital Preventive Maintenance Emulsion Requirements					
	HFRS-2M	CRS-2M	CSS-1mM	CSS-1hM	PPSS	CSEA
Ductility, 4°C, 5 cm/min, cm, T51/D113	—	—	35	—	—	—
Elastic/recovery, 4°C,% min., T301/D6084	—	—	65	—	—	—
Float test, sec, T50/D139:						
At 50°C, max.	—	—	—	—	—	—
At 60°C, min.	1200	—	—	—	—	—
Solubility in trichloroethylene, % min., T44/D2042	—	—	97.5	97.5	—	97.5
Ash content, %, max., D128	2	2	2	2	—	2
Specific gravity, 25/25°C, min., T228/D70	—	—	—	—	—	—
Toughness/tenacity, 25°C, 50 cm/min., Nm, min., D5801	4.5/3.5	4.5/3.5	—	—	—	9.0/7.0
Elastic recovery, 10°C, % min., T301/D6084	60%	60%	—	—	60%	75%
Tests on residue from evaporation, T59/D6934[h]						
Softening point, ring, and ball, °C, min., T53/D36	—	—	60	57.2	—	—
Viscosity, 60C, Pa•S, T202/D2171	—	—	800[i]	800[i]	—	—
Section number reference	—	505	504	501, 504	503	505

Table 904-7 (cont.):
Capital Preventive Maintenance Emulsions[(a)]

(a) Samples of emulsified asphalt will be taken in accordance with ASTM D140/D140M. Samples must be stored at a temperature of not less than 4°C until tested.

(b) After standing undisturbed for 24 hours, the surface must show no white, milky colored substance but must be a smooth homogenous color throughout. Any visible amount of white, milky colored substance is basis for non-acceptance.

(c) The demulsibility test must be made within 30 days from date of shipment.

(d) If particle charge test is inconclusive, material having a maximum pH of 6.7 is acceptable.

(e) No appreciable coagulation or visible separation in 2 hours.

(f) ASTM D6997, with modifications to include a 204°C (± 6°C) maximum temperature to be held for 15 minutes.

(g) Residue determination and preparation may use the alternative ASTM D6934 method, “Residue by Evaporation,” so as to not destroy the properties of any polymer modifiers contained therein.

(h) Residue by evaporation: Oven evaporate an emulsion sample on a glass plate at a maximum temperature of 60°C for 24 hours (forced draft oven recommended) or air dry the sample at ambient temperature for 3 days. Once dry, the sample is scraped from the plate using a razor blade tool.

(i) The minimum viscosity will be obtained using a Cannon-Manning Vacuum Capillary Viscometer Tube No. 14 per T202/D2171.

Table 904-8:
Temperatures for Asphaltic Materials

Asphalt Type	Designation	Temperature, °F Distributor
Cutback asphalts	RC-250	145–220
	MC-250	145–220
	MC-30	70–140
	MC-70	105–180
Emulsified	RS-1m, SS-1h, CSSmM, CRS-1, CSS-1h, CSS-1hM,	85–135
Asphalts	RS-2a, HFRS-2, HFRS-2M, MS-2h, MS-2s, CRS-2, CMS-2, CRS-2M	125–175
Asphalt binder	All grades	350 max. mixing temp[(a)]

(a) Mixing temperature for all asphalt binders will be as specified by the modifier/binder producer.

Section 905. Steel Reinforcement

905.01. General Requirements

Steel reinforcement for use in concrete structures and pavements must meet the requirements of this section.

905.02. Testing

Test steel reinforcement in accordance with ASTM A370, ASTM E8/E8M, or other specified ASTM, AASHTO, or Department methods, as modified by this section.

If requested, provide the Engineer with two copies of the chemical analysis of reinforcing bars in accordance with the relevant ASTM specifications.

905.03. Bar Reinforcement for Structures

Deformed steel bars used for non-prestressed concrete reinforcement must meet the requirements of ASTM A615/A615M, ASTM A706/A706M, or ASTM A996/A996M (Type A or Type R) for Grade 60 steel bars, unless otherwise required.

Deformed steel bars used for prestressed concrete reinforcement must meet the requirements of ASTM A615/A615M, ASTM A706/A706M, or ASTM A996/A996M (Type A) for Grade 60 steel bars, unless otherwise required.

A. **Bending**. Shop cold bend bar reinforcement to the shapes shown on the plans. Complete all field bending cold. Do not heat bars during bending.

The diameter of a bar bend, measured on the inside of the bar, must meet the requirements of Table 905-1.

Table 905-1:
Minimum Bend Diameters

ASTM Bar Designation No.	Minimum Inside Diameter of Bend (bar diameters)
No. 3 – No. 8	6
No. 9 – No. 11	8
No. 14, No. 18	10
Stirrups and ties, No. 3 – No. 5	4

Cut and bend bars in accordance with the *CRSI Manual of Standard Practice* and the *ACI Detailing Manual*.

B. **Bundling and Tagging.** Ship bar reinforcement in standard bundles, tagged and marked in accordance with the *CRSI Manual of Standard Practice*.

C. **Epoxy Coating.** Epoxy-coated steel reinforcement bars must be coated in accordance with ASTM A775/A775M. Epoxy-coated steel-welded wire reinforcement must be coated in accordance with ASTM A884/A884M, Class A, Type 1. The following exceptions and additions apply:

1. Select coating material from the Qualified Products List.
2. The Department may test samples to verify thickness of coating, adhesion of coating, and holidays. Coat more steel reinforcement than shown on the plans to allow splicing to replace steel reinforcement removed for test samples.
3. Include written certification from the coating applicator that the steel reinforcement was cleaned, coated, and tested in accordance with ASTM A775/A775M (for reinforcing bars) or ASTM A884/A884M (for reinforcing wire).
4. Repair damage to the coating in accordance with subsection 706.03.E.8.

D. **Bar Chairs and Wire Ties for Epoxy-Coated Steel Reinforcement.** Bar chairs and wire ties required for placing and fastening steel reinforcement must conform to the following:

1. Bar chairs must be plastic-coated wire, epoxy-coated wire, or plastic.
2. Wire ties must be plastic-coated wire, epoxy-coated wire, or molded plastic clips.
3. Tie-down wires must be plastic coated.

905.04. Bar Reinforcement for Pavements

Bar reinforcement for pavement tie bars and bars for use as dowels for load transfer in pavement expansion joints and contraction joints must meet the requirements of section 914.

905.05. Dowels and Bar Reinforcement for Curb, Glare Screen, Concrete Barriers, and Filler Walls

Deformed steel bars must meet the requirements of ASTM A615/A615M, ASTM A706/A706M, or ASTM A996/A996M (Type A or Type R) for Grades 40, 50, or 60 as applicable.

905.06. Steel-Welded Wire Reinforcement

Deformed steel-welded wire reinforcement must meet the requirements of ASTM A1064/A1064M and be fabricated as required.

905.07. Strand for Prestressed Concrete

Strands for prestressed concrete must have a 0.500-inch nominal diameter and a 0.153-square-inch cross sectional area or a 0.6000-inch nominal diameter and a 0.217-square-inch cross sectional area and must meet the requirements of ASTM A416/A416M for Grade 270, low relaxation strand, as required.

Identify each reel or pack number and provide a Test Data Certification, including a load elongation curve to at least 1% elongation.

Protect prestress strands from physical damage, rust, and contaminants.

905.08. Tendons for Lateral Post Tensioning of Box Beams

Tendons for lateral post tensioning of box beams must meet the requirements of ASTM A416/A416M for Grade 270 steel strand or ASTM A722/A722M for high-strength steel bars.

If selecting bars, consider the tolerances allowed in manufacturing and placing precast concrete box beams and determine the required bar lengths accordingly.

Section 909. Drainage Products

909.01. General Requirements

Use the pipe materials shown in Table 401-1 and Table 402-1 for culverts or sewers if only the size and class are specified by the contract. Construct drainage structures and underdrains as required.

Provide galvanized corrugated steel or aluminum structural plates as required. Galvanized corrugated steel structural plates must meet the requirements of AASHTO M167M/M167. Corrugated aluminum structural plates must meet the requirements of ASTM B790/B790M or Section 12 of the *AASHTO LRFD [Load and Resistance Factor Design] Bridge Specifications*.

Provide sanitary sewer or industrial waste systems in accordance with the contract. Install sanitary sewer or industrial waste systems using a compression gasket as specified in subsection 909.03.

909.02. Testing

Test drainage products in accordance with AASHTO or ASTM specifications unless otherwise specified in this section.

Verify that each concrete pipe manufacturer provides a calibrated standard testing machine to determine the strength of the product. The manufacturer must provide labor and materials to perform strength tests.

909.03. Watertight Joints for Sewers and Culverts

Provide watertight joint systems selected from the Qualified Products List. Ensure that watertight joint systems meet the pressure test requirements of MTM 723 and the specifications for the materials used in assembling the pipe system.

Use flexible rubber compression gaskets meeting the requirements of ASTM C443 for concrete pipe, ASTM F477 for plastic pipe, AASHTO M36 for corrugated metal pipe, and AASHTO M196 for corrugated aluminum pipe. As an alternative to the AASHTO M36 requirements for metal pipe, the Contractor may use gasket material meeting the low temperature flexibility and elevated temperature flow test requirements of ASTM C990, excluding the requirements for softening point, flash point, and fire point.

External rubber gaskets, mastic, and protective film must meet the requirements of ASTM C877 or C990.

909.04. Concrete Pipe Products

A. **Reinforced Concrete Circular Pipe.** Provide reinforced concrete circular pipe meeting the requirements of AASHTO M170 or AASHTO M242. If using AASHTO M242 pipe, the design loads must meet the requirements of AASHTO M170.

If using AASHTO M170 pipe, apply the following exceptions and additions:

1. The Contractor may use the circular pipe designs specified in Table 909-1, Table 909-2, Table 909-3, and Table 909-4 in addition to the circular pipe designs in Table 2, Table 3, Table 4, and Table 5 of AASHTO M170.
2. Cast or drill lift holes and seal with concrete plugs after installing the pipe. Cast lift holes in circular pipe with elliptical reinforcing along the top centerline of the pipe.
3. Use circular reinforcement in circular pipe for use in pipe culverts and sewers jacked in place. The concrete absorption test requirements will be waived if the load required to produce the 0.01-inch crack exceeds the minimum load by at least 20%.

If using stirrup supports, use indentations or waterproof paint to mark the top and bottom centerline of the pipe, inside and out, on each end of the pipe. Symmetrically place stirrup supports around the centerline in the top and bottom portion of the pipe. Pass stirrups around and in contact with each inside circumferential reinforcing member. Space the stirrups in accordance with Table 909-2, Table 909-3, and Table 909-4. Do not use more than three sections of stirrup material in one support line. Ensure a section length of at least 30 inches for each stirrup.

B. **Reinforced Concrete Elliptical Pipe.** Provide reinforced concrete elliptical pipe meeting the requirements of AASHTO M207. The concrete absorption test requirement will be waived if the load required to produce the 0.01-inch crack exceeds the required minimum load by at least 20%.

The Contractor may use the horizontal elliptical pipe designs specified in Table 909-5 and Table 1 of AASHTO M207.

C. **Non-Reinforced Concrete Pipe.** Provide non-reinforced concrete pipe meeting the requirements of AASHTO M86. Place required markings on the barrel of the pipe near the socket. Ensure that the markings remain legible during delivery of the pipe to the project.

D. **Precast Concrete Box Sections.** Use precast concrete box sections as required and in accordance with ASTM C1577.

E. **Concrete End Sections.** Provide precast concrete end sections fabricated using material meeting the requirements of AASHTO M170 for Class II and as shown on the plans. Provide wet-cast concrete for end sections with an entrained air content of 5.5 to 8.5%. When using the dry cast process, use at least 658 pounds of cement per cubic yard of concrete and use a liquid air-entraining agent at the dosage recommended by the manufacturer for dry cast concrete.

Use tongue and groove joints to make connections to pipe culverts.

F. **Pipe Culverts Jacked in Place.** For pipe culverts jacked in place, use reinforced concrete pipe at least 36 inches in diameter, meeting the requirements of AASHTO M170 for Class V, Wall B or C, with full circular reinforcing.

G. **Precast Concrete Three-Sided and Arch Sections.** Use precast concrete three-sided and arch sections as required and in accordance with ASTM C1504.

909.05. Metal Pipe Products

For metal pipe products, refer to Table 909-6 for the minimum wall thickness, or refer to Table 909-7 through Table 909-17, and Table 909-20 to determine the required wall thickness.

Refer to Table 909-19 for gauge equivalents for specified nominal thicknesses.

A. **Corrugated Steel Pipe.** Provide circular and pipe arch corrugated steel pipe meeting the requirements of AASHTO M36 for metallic-coated pipe. For polymer-precoated pipe, provide circular and pipe arch corrugated steel pipe meeting the requirements of AASHTO M245 and using an ethylene acrylic acid film selected from the Qualified Products List.

The Contractor may use Type IA and Type IIA dual-wall polymer-precoated galvanized corrugated steel pipe of the wall thicknesses specified in Table 909-20 and specified in subsection 909.05.

1. **Steel Sheet**. Provide corrugated steel pipe from zinc-coated sheets meeting the requirements of AASHTO M218 or from aluminum-coated sheets meeting the requirements of AASHTO M274.

On zinc-coated steel sheet for polymer-precoated corrugated steel pipe, use ethylene acrylic acid film selected from the Qualified Products List meeting the requirements of AASHTO M246 for Grade 250/250 polymer. Use only lock seam pipe.

Verify that the metallic coating weight on individual samples of fabricated pipe or steel sheet meets the single spot and triple spot test

requirements in accordance with AASHTO M218. Refer to Table 909-6, Table 909-7, Table 909-8, Table 909-9, Table 909-10, Table 909-11, and 909-20 for the specified nominal sheet thickness for a given diameter, class, and size of corrugation of culvert or sewer pipe.

Provide pipe less than 12 inches in diameter, fabricated from steel sheet with a minimum thickness of at least 0.064 inch (16 gauge).

2. **End Finish for Helical Corrugated Pipe.** For helical corrugated pipe, except perforated pipe, with diameters of at least 12 inches, reroll the pipe ends to form at least two circumferential corrugations in accordance with AASHTO M36 or AASHTO M245. This end treatment for perforated pipe and pipe with diameters less than 12 inches and pipe that spans the road surface in a single section is optional for the fabricator.

3. **Coupling Bands**. To connect sections of pipe and to attach end sections to culvert pipe with diameters of at least 12 inches, except perforated pipe, provide coupling bands circumferentially corrugated with the same size corrugations as on the ends of the pipe or use universal bands with gaskets.

   For coupling bands with diameters no greater than 10 inches, use coupling bands with corrugations matching the pipe corrugations.

   The Contractor may connect perforated pipe with a diameter no greater than 12 inches with smooth sleeve-type couplers. For perforated pipe with diameters greater than 12 inches, use coupling bands with corrugations matching the pipe corrugations, dimple bands, or universal bands.

   Provide coupling band connections as specified in subsection 401.03 and meeting the requirements of AASHTO M36 or AASHTO M245.

B. **Corrugated Aluminum Alloy Pipe.** Provide corrugated aluminum alloy pipe meeting the requirements of AASHTO M196, except fabricate pipe from aluminum sheet with the nominal thickness specified in Table 909-12, Table 909-13, Table 909-14, Table 909-15, Table 909-16, and Table 909-17.

   Only use Type IA and Type IIA corrugated aluminum alloy pipe if directed by the Engineer.

C. **Steel End Sections.** Provide steel end sections with coupling bands or hardware as shown on the plans. Metallic coating on the end sections must be the same as the metallic coating on the pipe, except zinc-coated steel end sections may be used with aluminum-coated steel pipe and

polymer-coated steel pipe. Provide metal end sections meeting the requirements of AASHTO M36.

D. **Steel Pipe for Jacking in Place.** Provide steel pipe for jacking in place meeting the requirements of ASTM A53/A53M for Type E or Type S, Grade B, or ASTM A139/A136M for Grade B. Provide a continuous welded joint to create a watertight casing that is capable of withstanding handling and installation stresses. Perform field welding using the shielded metal arc welding process and using E6011 or E7018 electrodes.

909.06. Plastic Pipe Products

Provide smooth-lined corrugated polyethylene (CPE) pipe and required fittings meeting the requirements of AASHTO M294 for Type S.

Provide corrugated polyvinyl chloride (CPV) pipe and required fittings meeting the requirements of AASHTO M304. The Engineer will test CPV pipe in accordance with MTM 728.

If providing a separate fitting or coupling to ensure a watertight joint in corrugated plastic pipe culverts and sewers, use non-corrugated, solid sleeve, fabricated from polyethylene (PE), or polyvinyl chloride (PVC) with a gasket meeting the requirements of subsection 909.03 on both sides of the joint. Do not use split collar couplers.

Provide a pipe indentation in each sleeve in the center to ensure positioning of the pipe sections in the field. Factory-installed sleeves on one end of the pipe sections and place a removable protective material over the exposed gaskets. Lubricate gaskets and sleeves before insertion according to manufacturer's recommendations.

909.07. Pipe for Underdrains

A. **Smooth Plastic Pipe for Underdrain.** Provide smooth plastic pipe for underdrain, fabricated from PVC pipe meeting the requirements of AASHTO M278. For pipes no greater than 6 inches in diameter, the Contractor may use acrylonitrile-butadiene-styrene (ABS) pipe meeting the requirements of ASTM D2751 for SDR 35 with perforations meeting the requirements of AASHTO M278, except that the joint tightness requirements do not apply.

B. **Corrugated Plastic Tubing for Underdrain.** Provide corrugated plastic tubing for underdrain meeting the requirements of AASHTO M252 for PE tubing or ASTM F949 for PVC tubing. Ensure that the perforations for PE and PVC tubing meet the requirements of AASHTO M252.

C. **Underdrain Outlets.** Provide PVC pipe underdrain outlets meeting one of the following requirements:

1. ASTM D1785 Schedule 40;
2. ASTM D2665;
3. ASTM D3034, for Type SDR 23.5; or
4. Corrugated steel pipe in accordance with subsection 909.05.A.

D. **Connections.** Seal connections with tape recommended by the manufacturer for underground service conditions. Provide tape resistant to moisture and organic growth.

909.08. Pipe for Downspouts

A. **Bridge Deck Downspouts.** Provide bridge deck downspouts of PE pipe meeting the requirements of ASTM F714, PE 4710, DR 26, Schedule 80 PVC. The Contractor may provide bridge deck downspouts of fiberglass-reinforced thermosetting resin pipe with a short-term rupture hoops tensile stress of at least 30,000 psi in accordance with ASTM D2996. PVC pipe must be in accordance with ASTM D1785 and ASTM D4216 to prevent changes in color, physical properties, and appearance due to weathering.

B. **Culvert, Downspouts.** If shown on the plans, provide other culvert downspouts made from one of the following:

1. Corrugated steel pipe as specified in subsection 909.05.A;
2. Corrugated aluminum alloy pipe as specified in subsection 909.05.B; or
3. CPE pipe meeting the requirements of AASHTO M294 for Type C.

Provide fittings required for CPE pipe meeting the requirements of AASHTO M294.

Seal joints between lengths of pipe, as recommended by the pipe manufacturer, to form silt-tight joints. Provide end sections as shown on the plans and specified in subsection 909.04.D or subsection 909.05.C.

C. **Bridge Deck Drain Extensions.** Provide bridge deck drain extensions as an integral component of the drain casting assembly in accordance with *MDOT Standard Plan B-101* series.

909.09. Cold-Applied Pipe Joint Sealer

Provide asphaltic material for sealing joints in concrete or clay pipe that can be spread on the joints with a trowel at an air temperature from 14 to 100°F.

The material must not flow, crack, or become brittle if exposed to the atmosphere. Verify that the material adheres to the concrete or clay to make a watertight seal.

Deliver the sealer to the project in sealed containers. Protect the sealer from contamination. Mark the container with “Cold Applied Pipe Joint Sealer” and the brand name, net volume or weight, and application requirements.

909.10. Drainage Marker Posts

Provide drainage marker posts meeting the requirements for plastic or steel delineator posts as specified in section 919 or the requirements for steel line fence posts in section 907, except provide posts at least 6 feet long. The Contractor may submit alternative post materials to the Engineer for approval.

909.11. Rodent Screens

Provide rodent screens of hardware cloth meeting the requirements of ASTM A740 with an opening size no greater than 0.30 inch, except provide wire of a nominal size of 0.057 inch and a minimum zinc coating weight of 0.59 ounce per square foot of uncoated wire surface, applied after weaving. The Contractor may substitute fabric made of Type 304 stainless steel wire with an opening no greater than 0.30 inch and a 0.057-inch nominal wire diameter. The Contractor may submit other screens with openings no greater than 0.30 inch to the Engineer for approval.

Form the screen using a punch and die. After shaping, ensure that the fabric forms a cylinder slightly larger than the inside diameter of the outlet pipe.

Table 909-1:
Additional Designs For Class II Reinforced Concrete Pipe
(AASHTO M170 Table 2 Extended)

Internal Diameter of Pipe (inch)	Minimum Wall Thickness (inch)	Reinforcement per Foot of Pipe Wall (sq in)			
		Circular Reinforcement in Circular Pipe		Elliptical Reinforcement in Circular Pipe	
		Inner Cage	Outer Cage	Inner Circular Cage	Elliptical Cage
114	9.5	0.56	0.34	0.22	0.34
120	10	0.61	0.37	0.24	0.37
126	10.5	0.65	0.39	0.26	0.39
132	11	0.70	0.42	0.28	0.42
144	12	0.80	0.48	0.32	0.48

Notes:
D-load = pound-force per linear foot per foot of diameter
D-load to produce a 0.01-inch crack: 1,000
D-load to produce the ultimate load: 1,500
Concrete strength: 5,000 psi

Table 909-2:
Additional Designs for Class III Reinforced Concrete Pipe (AASHTO M170 Table 3 Extended)

Internal Diameter of Pipe (inch)	Minimum Wall Thickness (inch)	Reinforcement per foot of Pipe Wall (sq in)				Stirrup Support System					
		Circular Reinforcement in Circular Pipe		Elliptical Reinforcement in Circular Pipe							
		Inner Cage	Outer Cage	Inner Circular Cage	Elliptical Cage	Minimum Area per Support Element, (sq in)[a]	No. of Lines[b]	Long. Spacing (inch)	Circum. Spacing on Inner Cage (inch)	Amplitude of Supports (inch)[c]	Ave. Area (sq in per ft per line)[d]
114	9½	0.69	0.41	0.28	0.41	0.041	5	2	6⅛	6.68	0.242
120	10	0.74	0.44	0.30	0.44	0.041	5	2	6½	7.16	0.242
126	10½	0.79	0.47	0.32	0.47	0.041	5	2	6⅞	7.68	0.242
132	11	0.85	0.51	0.34	0.51	0.041	5	2	7¼	8.16	0.242
144	12	0.97	0.58	0.39	0.58	0.041	5	2	8	9.16	0.242

Notes:
D-load = pound-force per linear foot per foot of diameter
D-load to produce a 0.01-inch crack: 1,350
D-lad to produce the ultimate load: 2,000
Concrete strength: 5,000 psi
Where a stirrup system is shown for a given size, it must be used with the circumferential reinforcement design selected.

(a) Two times the cross-sectional area of the wire used in the stirrup support system using 2- × 8-inch pattern for inner cage steel.

(b) Number of longitudinal lines required in the top and in the bottom portions of the pipe.

(c) Overall width of each line of stirrup support system using 2- × 8-inch pattern for inner cage steel. Use with Shearlock stirrups or S-stirrups or equal.

(d) Minimum area per support times number of supports per foot using 2- × 8-inch pattern for inner cage steel.

Table 909-3:
Additional Designs for Class IV Reinforced Concrete Pipe (AASHTO M170 Table 4 Extended)

Internal Diameter of Pipe, (in)	Minimum Wall Thickness, (in)	Reinforcement per Foot of Pipe Wall (sq in)				Stirrup Support System					
		Circular Reinforcement in Circular Pipe		Elliptical Reinforcement in Circular Pipe							
		Inner Cage	Outer Cage	Inner Circular Cage	Elliptical Cage						
		Concrete Strength, 5,500 psi				Minimum Area per Support Element (square inch)[a]	Number of Lines[b]	Long. Spacing (inch)	Circum. Spacing on Inner Cage (inch)	Amplitude of Supports (inch)[c]	Ave. Area (square inch per foot per line)[d]
78	7½	0.87	0.52	0.35	0.52						
84	8	1.00	0.60	0.40	0.64						
—	—	Concrete Strength, 5,000 psi									
78	7½	0.69	0.41	0.28	0.41	0.028	11	2	4⅛	4.67	0.167
84	8	0.74	0.44	0.30	0.44	0.028	11	2	4⅝	5.17	0.167
90	8	0.85	0.51	0.34	0.51	0.028	11	2	4⅝	5.17	0.167
96	8½	0.91	0.55	0.36	0.55	0.028	11	2	5⅛	5.67	0.167
102	8½	1.02	0.61	0.41	0.61	0.033	11	2	5⅛	5.67	0.195
108	9	1.07	0.64	0.43	0.64	0.043	11	2	5⅝	6.17	0.260
114	9½	1.02	0.61	0.41	0.61	0.047	11	2	6⅛	6.67	0.279
120	10	1.10	0.66	0.44	0.66	0.050	11	2	6½	7.17	0.298
126	10½	1.17	0.70	0.47	0.70	0.053	11	2	6⅞	7.67	0.316
132	11	1.25	0.75	0.50	0.75	0.056	11	2	7¼	8.17	0.335
144	12	1.42	0.85	0.57	0.85	0.064	11	2	8	9.17	0.381

Table 909-3 (cont.):
Additional Designs for Class IV Reinforced Concrete Pipe (AASHTO M170 Table 4 Extended)

Notes:

D-load = pound-force per linear foot per foot of diameter
D-load to produce a 0.01-inch crack: 2,000
D-load to produce the ultimate load: 3,000
Where a stirrup system is shown for a given size, it must be used with the circumferential reinforcement design selected.

(a) Two times the cross-sectional area of the wire used in the S-stirrups.

(b) Number of longitudinal lines required in the top and in the bottom portions of the pipe.

(c) Overall width of each line of stirrup support system using 2- × 8-inch in pattern for inner cage steel. Use with Shearlock stirrups or S-stirrups or equal.

(d) Minimum area per support times number of supports per foot using 2- × 8-inch pattern for inner cage steel.

Table 909-4:
Additional Designs for Class V Reinforced Concrete Pipe (AASHTO M170 Table 5 Extended)

Internal Diameter of Pipe (inch)	Wall Thickness (inch min.)	Reinforcement per Foot of Pipe Wall (sq in)				Stirrup Support System					
		Circular Reinforcement in Circular Pipe		Elliptical Reinforcement in Circular Pipe							
		Inner Cage	Outer Cage	Inner Circular Cage	Elliptical Cage	Minimum Area per Support Element (sq in)[a]	Number of Lines[b]	Long. Spacing (inch)	Circum. Spacing on Inner Cage (inch)	Amplitude of Supports (inch)[c]	Ave. Area, (square inch per foot per line)[d]
54	5½	0.64	0.38	0.26	0.38	0.028	15	2	2⅛	2.68	0.167
60	6	0.70	0.42	0.28	0.42	0.028	14	2	2⅝	3.20	0.167
66	6½	0.79	0.47	0.32	0.47	0.028	13	2	3⅛	3.68	0.167
72	7	0.87	0.52	0.35	0.52	0.028	12	2	3⅝	4.16	0.167
78	7½	0.92	0.55	0.37	0.55	0.028	11	2	4⅛	4.68	0.167
84	8	0.99	0.59	0.40	0.59	0.033	11	2	4⅝	5.16	0.195
90	8	1.13	0.68	0.45	0.68	0.040	11	2	4⅝	5.16	0.248
96	8½	1.20	0.72	0.48	0.72	0.043	11	2	5⅛	5.68	0.260
102	8½	1.34	0.80	0.54	0.80	0.051	11	2	5⅛	5.68	0.307
108	9	1.51	0.91	0.60	0.91	0.061	11	2	5⅝	6.16	0.363
114	9½	1.51	0.91	0.60	0.91	0.062	11	2	6⅛	6.68	0.372
120	10	1.62	0.97	0.65	0.97	0.067	11	2	6½	7.16	0.400

Table 909-4 (cont.):
Additional Designs for Class V Reinforced Concrete Pipe (AASHTO M170 Table 5 Extended)

Internal Diameter of Pipe (inch)	Wall Thickness (inch min.)	Reinforcement per Foot of Pipe Wall (sq in)				Stirrup Support System					
		Circular Reinforcement in Circular Pipe		Elliptical Reinforcement in Circular Pipe							
		Inner Cage	Outer Cage	Inner Circular Cage	Elliptical Cage	Minimum Area per Support Element (sq in)[a]	Number of Lines[b]	Long. Spacing (inch)	Circum. Spacing on Inner Cage (inch)	Amplitude of Supports (inch)[c]	Ave. Area, (square inch per foot per line)[d]
126	10½	1.73	1.04	0.69	1.04	0.070	11	2	6⅞	7.68	0.419
132	11	1.84	1.10	0.74	1.10	0.074	11	2	7¼	8.16	0.446
144	12	2.09	1.25	0.84	1.25	0.082	11	2	8	9.16	0.493

Notes:

D-load = pound-force per linear foot per foot of diameter
D-load to produce a 0.01-inch crack: 3,000
D-load to produce the ultimate load: 3,750
Concrete strength: 6,000 psi
Where a stirrup system is shown for a given size, it must be used with the circumferential reinforcement design selected.

(a) Two times the cross-sectional area of the wire used in the Stirrups Support System using 2 × 8-inch pattern for inner cage steel. Use with Shearlock stirrups or S-stirrups or equal.

(b) Number of longitudinal lines required in the top and in the bottom portions of the pipe.

(c) Overall width of each line of stirrups.

(d) Minimum area per support times number of supports per foot using 2 × 8-inch pattern for inner cage steel.

Table 909-5:
Additional Designs for Horizontal Elliptical Pipe

Specified Diam., Equiv. Round Size (inch)	Specified Rise by Span (inch)	Min. Wall Thick (inch)	Reinforcement (square inch per foot)													
			Class HE-A		Class HE-I		Class HE-II		Class HE-III		Class HE-IV					
			D-Loads										Stirrup Support System			
			0.01 = 600		0.01 = 800		0.01 = 1000		0.01 = 1350		0.01 = 2000		Min. Area per Support Element (square inch)	Number of Lines[a]	Long. Spacing (inch)	Circum. Spacing on Inner Cage (inch)[b]
			Ult = 900		Ult = 1200		Ult = 1500		Ult = 2000		Ult = 3000					
			In Cage	Out Cage	In Cage	Out Cage	In Cage	Out Cage	In Cage	Out Cage	In Cage	Out Cage				
48	38 × 60	5½	—	—	—	—	—	—	—	—	0.70	0.70	0.13	15	2	3.000
54	43 × 68	6	—	—	—	—	—	—	—	—	0.82	0.82	0.15	15	2	3.375
60	48 × 76	6½	—	—	—	—	—	—	—	—	0.94	0.94	0.17	15	2	3.750
66	53 × 83	7	—	—	—	—	—	—	—	—	0.99	0.99	0.17	15	2	4.125
72	58 × 91	7½	—	—	—	—	—	—	—	—	1.11	1.11	0.19	15	2	4.500
84	63 × 98	8	—	—	—	—	—	—	—	—	1.21	1.21	0.21	15	2	4.875
78	68 × 106	8½	—	—	—	—	—	—	—	—	1.33	1.33	0.22	15	2	5.250
90	72 × 113	9	0.28	0.28	0.40	0.40	0.58	0.58	—	0.84	1.43	1.43	0.24	15	2	5.625
96	77 × 121	9½	0.30	0.30	0.45	0.45	0.65	0.65	0.92	0.92	1.56	1.56	0.26	15	2	6.000
102	82 × 128	9¾	0.33	0.33	0.52	0.52	0.73	0.73	1.03	1.03	1.72	1.72	0.28	15	2	6.188
108	87 × 136	10	0.36	0.36	0.60	0.60	0.83	0.83	1.16	1.16	1.92	1.92	0.30	15	2	6.375
114	92 × 143	10½	0.40	0.40	0.64	0.64	0.88	0.88	1.23	1.23	2.02	2.02	0.32	15	2	6.750
120	97 × 151	11	0.44	0.44	0.70	0.70	0.96	0.96	1.32	1.32	2.16	2.16	0.34	15	2	7.125

Table 909-5 (cont.):
Additional Designs for Horizontal Elliptical Pipe

Specified Diam., Equiv. Round Size (inch)	Specified Rise by Span (inch)	Min. Wall Thick (inch)	Reinforcement (square inch per foot)													
			Class HE-A		Class HE-I		Class HE-II		Class HE-III		Class HE-IV					
			D-Loads										Stirrup Support System			
			0.01 = 600		0.01 = 800		0.01 = 1000		0.01 = 1350		0.01 = 2000		Min. Area per Support Element (square inch)	Number of Lines[a]	Long. Spacing (inch)	Circum. Spacing on Inner Cage (inch)[b]
			Ult = 900		Ult = 1200		Ult = 1500		Ult = 2000		Ult = 3000					
			In Cage	Out Cage	In Cage	Out Cage	In Cage	Out Cage	In Cage	Out Cage	In Cage	Out Cage				
132	106 × 166	12	0.53	0.53	0.81	0.81	1.09	1.09	1.49	1.49	2.40	2.40	0.38	15	2	7.875
144	116 × 180	13	0.61	0.61	0.91	0.91	1.21	1.21	1.64	1.64	2.62	2.62	0.42	15	2	8.625
Concrete strength (psi)			4,000		4,000		4,000		5,000		48 inch, 54 inch, 60 inch 4,000					
											66-144 inch 5,000					

Note: Where a stirrup system is shown for a given size, it must be used with the circumferential reinforcement design selected.

(a) Number of longitudinal lines required in the top and in the bottom portions of the pipe.

(b) Overall width of each line of stirrups.

Table 909-6:
References for Spiral Ribbed and Corrugated Metal Pipes

	Driveway Culverts and Downspouts	Culverts	Sewers
	Minimum Design Life		
Pipe Material Type	**25 years**	**50 years**	**70 years**
Galvanized spiral ribbed metal pipe	Table 909-8	0.109[(a)]	0.168[(a)]
Aluminized Type 2 spiral ribbed metal pipe	Table 909-8	Table 909-11	0.138[(a)]
Polymer-precoated spiral ribbed metal pipe	Table 909-8	Table 909-8	Table 909-8
Galvanized corrugated metal pipe	Table 909-7	Table 909-9	0.168[(a),(b)]
Aluminized Type 2 corrugated metal pipe	Table 909-7	Table 909-10	0.138[(a),(b)]
Polymer-precoated corrugated galvanized pipe	Table 909-7	Table 909-7	Table 909-7[(b)]
Aluminum pipe	Table 909-12	Table 909-13	Table 909-14
Aluminum spiral ribbed pipe	Table 909-15	Table 909-16	Table 909-17
Dual-wall polymer-precoated galvanized corrugated steel pipe	Table 909-20	Table 909-20	Table 909-20

Notes:

Minimum wall thickness in inches to meet structural and durability requirements for various metal pipes to meet the design life.
Numbers represent the minimum durability gage requirements for the specific pipe material.
Table 909-7 represents the minimum structural gauge thickness requirements for corrugated steel pipe.
Table 909-8 represents the minimum structural gauge thickness requirements for spiral ribbed steel pipe.

(a) Required wall thickness (inch).

(b) Permitted for 12- to 18-inch-diameter 2⅔- × ½-inch helically corrugated pipe only.

Table 909-7:
Wall Thickness Requirements in Inches, Based on Diameter Class of Pipe and Size of Corrugation

Pipe Diameter (inch)	Depth of Cover							
	0–16 feet		>16–24 feet			>24–32 feet		
	Corrugation Size (inch)							
	2⅔ × ½	3 × 1, 5 × 1	2⅔ × ½	3 × 1	5 × 1	2⅔ × ½	3 × 1	5 × 1
	Required Wall Thickness (inch)							
12–30	0.064	—	0.064	—	—	0.064	—	—
36–48	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
54	0.079	0.064	0.079	0.064	0.064	0.079	0.064	0.064
60	0.109	0.064	0.109	0.064	0.064	0.109	0.064	0.064
66	0.138	0.064	0.138	0.064	0.064	0.138	0.064	0.064
72	0.138	0.064	0.138	0.064	0.064	0.138	0.064	0.064
78	0.168	0.064	0.168	0.064	0.064	0.168	0.064	0.064
84	0.168	0.064	0.168	0.064	0.064	0.168	0.064	0.079
90	—	0.064	—	0.064	0.064	—	0.079	0.079
96	—	0.079	—	0.079	0.079	—	0.079	0.079
102	—	0.079	—	0.079	0.079	—	0.079	0.109
108–120	—	0.109	—	0.109	0.109	—	0.109	0.109
126	—	0.138	—	0.138	0.138	—	0.138	0.138
130–136	—	0.138	—	0.138	0.138	—	0.138	0.138
144	—	0.168	—	0.168	0.168	—	0.168	0.168

Table 909-8:
Wall Thickness Requirements in Inches Based on Diameter, Class of Pipe, and Size of Ribs

Pipe Diameter (inch)	Depth of Cover					
	0–16 feet		>16–24 feet		>24–32 feet	
	Corrugation Size (inch)					
	¾ × ¾ × 7½	¾ × 1 × 11½	¾ × ¾ × 7½	¾ × 1 × 11½	¾ × ¾ × 7½	¾ × 1 × 11½
	Required Wall Thickness (inch)					
18–36	0.064	0.064	0.064	0.064	0.064	0.064
42	0.064	0.064	0.064	0.064	0.064	0.079
48	0.064	0.064	0.064	0.079	0.064	0.079
54	0.079	0.064	0.079	0.079	0.079	0.109
60	0.079	0.079	0.079	0.079	0.079	0.109
66	0.109	0.079	0.109	0.109	0.109	0.109
72–78	0.109	0.109	0.109	0.109	0.109	0.109
84	—	0.109	—	0.109	—	0.109

Table 909-9:
Wall Thickness Requirements in Inches Based on Class of Pipe and Size of Corrugation

Pipe Diameter (inch)	Class A and Class B		Class C		Class D		
	Corrugation Size (inch)						
	2⅔ × ½	3 × 1, 5 × 1	2⅔ × ½	3 × 1, 5 × 1	2⅔ × ½	3 × 1	5 × 1
	Required Wall Thickness (inch)						
12–30	0.109	—	0.109	—	0.109	—	—
36–60	0.109	0.109	0.109	0.109	0.107	0.109	0.109
66–72	0.138	0.109	0.138	0.109	0.138	0.109	0.109
78–84	0.168	0.109	0.168	0.109	0.168	0.109	0.109
90–102	—	0.109	—	0.109	—	0.109	0.109
108–120	—	0.109	—	0.109	—	0.109	0.109
126	—	0.138	—	0.138	—	0.138	0.138
130–136	—	0.138	—	0.138	—	0.138	0.138
144	—	0.168	—	0.168	—	0.168	0.168

Table 909-10:
Wall Thickness Requirements in Inches Based on Diameter, Class of Pipe and Size of Corrugation

Pipe Diameter (inch)	Class A and B		Class C			Class D		
	Corrugation Size (inch)							
	2⅔ × ½	3 × 1, 5 × 1	2⅔ × ½	3 × 1	5 x 1	2⅔ × ½	3 × 1	5 x 1
	Required Wall Thickness (inch)							
12–30	0.079	—	0.079	—	—	0.079	—	—
36–54	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079
60	0.109	0.079	0.109	0.079	0.079	0.109	0.079	0.079
66–72	0.138	0.079	0.138	0.079	0.079	0.138	0.079	0.079
78–84	0.168	0.079	0.168	0.079	0.079	0.168	0.079	0.079
90–96	—	0.079	—	0.079	0.079	—	0.079	0.079
102	—	0.079	—	0.079	0.079	—	0.079	0.109
108–120	—	0.109	—	0.109	0.109	—	0.109	0.109
126	—	0.138	—	0.138	0.138	—	0.138	0.138
130–136	—	0.138	—	0.138	0.138	—	0.138	0.138
144	—	0.168	—	0.168	0.168	—	0.168	0.168

Table 909-11:
Wall Thickness Requirements in Inches Based on Diameter, Class of Pipe, and Size of Ribs

Pipe Diameter (inch)	Class A and B		Class C		Class D	
	Corrugation Size (inch)					
	¾ × ¾ × 7½	¾ × 1 × 11½	¾ × ¾ × 7½	¾ × 1 × 11½	¾ × ¾ × 7½	¾ × 1 × 11½
	Required Wall Thickness (inch)					
18–48	0.079	0.079	0.079	0.079	0.079	0.079
54–60	0.079	0.079	0.079	0.079	0.079	0.109
66–78	0.109	0.109	0.109	0.109	0.109	0.109
84	—	0.109	—	0.109	—	0.109

Table 909-12:
Wall Thickness Requirements in Inches, Based on Class of Pipe and Size of Corrugation, Lock Seam Pipe Only

Pipe Diameter (inch)	Depth of Cover					
	0–16 feet		>16–24 feet		>24–32 feet	
	Corrugation Size (inch)					
	2⅔ × ½	3 × 1	2⅔ × ½	3 × 1	2⅔ × ½	3 × 1
	Required Wall Thickness (inch)					
12–27	0.060	0.060	0.060	0.060	0.060	0.060
30–36	0.075	0.060	0.075	0.060	0.075	0.060
42–54	0.105	0.060	0.105	0.060	0.105	0.060
60	0.135	0.075	0.135	0.075	0.135	0.075
66–72	0.164	0.075	0.164	0.075	0.164	0.075
78	—	0.075	—	0.075	—	0.075
84–96	—	0.105	—	0.105	—	0.105
102–108	—	0.135	—	0.135	—	0.135
112–120	—	0.164	—	0.164	—	0.164

Table 909-13:
Wall Thickness Requirements in Inches, Based on Class of Pipe and Size of Corrugation, Lock Seam Pipe Only

Pipe Diameter (inch)	Class A, B, C, D Corrugation Size (inch)	
	2⅔ × ½	3 × 1
	Required Wall Thickness (inch)	
12–36	0.075	0.075
42–54	0.105	0.075
60	0.135	0.075
66–72	0.164	0.075
78	—	0.075
84–96	—	0.105
102–108	—	0.135
112–120	—	0.164

Table 909-14:
Wall Thickness Requirements in Inches, Based on Class of Pipe and Size of Corrugation, Lock Seam Pipe Only

Pipe Diameter (inch)	Class A, B, C, D Corrugation Size (inch)	
	2⅔ × ½	3 × 1
	Required Wall Thickness (inch)	
12–54	0.105	0.105
60	0.135	0.105
66–72	0.164	0.105
78–96	—	0.105
102–108	—	0.135
112–120	—	0.164

Table 909-15:
Wall Thickness Requirements in Inches, Based on Diameter, Class of Pipe, and Size of Rib, Lock Seam Pipe Only

Pipe Diameter (inch)	Class F, ¾ × ¾ × 7½
	Required Wall Thickness (inch)
18–24	0.060
30–36	0.075
42–54	0.105
60–66	0.135

Table 909-16:
Wall Thickness Requirements in inches, Based on Diameter, Class of Pipe, and Size of Rib, Lock Seam Pipe Only

	Class A, B, C, D ¾ × ¾ × 7½
Pipe Diameter (inch)	Required Wall Thickness (inch)
18–36	0.075
42–54	0.105
60–66	0.135

Table 909-17:
Wall Thickness Requirements in Inches, Based on Diameter, Class of Pipe, and Size of Rib, Lock Seam Pipe Only

	Class A, B, C, D ¾ × ¾ × 7½
Pipe Diameter (inch)	Required Wall Thickness (inch)
18–54	0.105
60–66	0.135

Table 909-18:
Jacked-in-Place Steel Pipe Nominal OD and Wall Thickness

Nominal Size (inch)	Nominal Outside Diameter (inch)	Wall Thickness (inch)
2	2.375	0.154
4	4.500	0.188
6	6.625	0.188
8	8.625	0.188
10	10.750	0.188
12	12.750	0.188
14	14.000	0.250
16	16.000	0.250
18	18.000	0.250
20	20.000	0.250
24	24.000	0.250
30	30.000	0.312
36	36.000	0.312
42	42.000	0.438
48	48.000	0.500
54	54.000	0.563

Table 909-19:
Gage Equivalents to Nominal Thickness

Sheet Gauge Number	Nominal Thickness	
	Galvanized	Aluminum Alloy
18	0.052	0.048
16	0.064	0.060
14	0.079	0.075
12	0.109	0.105
10	0.138	0.135
8	0.168	0.164
7	0.188	—
5	0.218	—
3	0.249	—
1	0.280	—

Table 909-20:
Dual Wall Polymer-Precoated Galvanized Corrugated Steel Pipe Wall Thickness Requirements in inches Based on Diameter and Size of Corrugation

Diameter of Pipe (inch)	Corrugation Size (inch)			
	2⅔ × ½		3 × 1	
	Shell	Liner	Shell	Liner
	Required Wall Thickness (inch)			
36–48	0.064	0.052	0.064	0.052
54	0.079	0.052	0.064	0.052
60	0.109	0.052	0.064	0.052
66–72	0.138	0.052	0.064	0.052
78–84	0.168	0.052	0.064	0.052
90–102	—	—	0.079	0.052
108–120	—	—	0.109	0.052
126–136	—	—	0.138	0.052
144	—	—	0.168	0.052

Table 909-21:
Corrugated Steel Pipe (CSP) AASHTO LRFD Cover Heights for CSP Pipe-Arch 3 x 1 inch

Span x Rise (inch)	Equiv Diam. (inch)	Min. Nominal Thickness (inch)[(a)]	Min. Cover (feet)	Max. Cover (feet)
53 x 41	48	0.079	2.0	11
60 x 46	54	0.079	2.0	20
66 x 51	60	0.079	1.2	20
73 x 55	66	0.079	1.2	20
81 x 59	72	0.079	1.5	16
87 x 63	78	0.079	1.5	16
95 x 67	84	0.079	1.5	16
103 x 71	90	0.079	1.5	16
112 x 75	96	0.109	1.5	16
117 x 79	102	0.109	1.5	16
128 x 83	108	0.138	1.5	16
137 x 87	114	0.138	1.6	16
142 x 91	120	0.138	1.6	16

(a) Manufacturing limitations include a 0.079-inch minimum nominal thickness for 3- x 1-inch pipe-arch.

Table 909-22:
Corrugated Steel Pipe (CSP) AASHTO LRFD Cover Heights for CSP Pipe-Arch, 5 x 1 inch

Span x Rise (inch)	Equiv Diam. (inch)	Min. Nominal Thickness (inch)[(a)]	Min. Cover (feet)	Max. Cover (feet)
53 x 41	48	0.109	2.0	11
60 x 46	54	0.109	1.2	20
66 x 51	60	0.109	1.2	20
73 x 55	66	0.109	1.2	20
81 x 59	72	0.109	1.5	16
87 x 63	78	0.109	1.5	16
95 x 67	84	0.109	1.5	16
103 x 71	90	0.109	1.5	16
112 x 75	96	0.109	1.5	16
117 x 79	102	0.109	1.5	16
128 x 83	108	0.138	1.5	16
137 x 87	114	0.138	1.6	16
142 x 91	120	0.138	1.6	16

(a) Manufacturing limitations include a 0.109-inch minimum nominal thickness for 5- x 1-inch pipe-arch.

Table 909-23:
Corrugated Steel Pipe (CSP) AASHTO LRFD Cover Heights for CSP Pipe-Arch 2⅔ inch x ½ inch

Span x Rise (inch)	Equiv Diam. (inch)	Min. Nominal Thickness (inch)	Min. Cover (feet)	Max. Cover (feet)
17 x 13	15	0.064	1.9	12
21 x 15	18	0.064	2.0	12
24 x 18	21	0.064	1.9	12
28 x 20	24	0.064	2.0	12
35 x 24	30	0.064	2.0	12
42 x 29	36	0.064	2.0	12
49 x 33	42	0.079	2.0	12
57 x 38	48	0.109	2.0	11
64 x 43	54	0.109	2.0	11
71 x 47	60	0.138	2.0	11
77 x 52	66	0.168	2.0	12
83 x 57	72	0.168	2.0	12

Table 909-24:
Corrugated Steel Pipe (CSP) AASHTO LRFD Cover Heights for CSP Pipe-Arch ¾ inch x ¾ inch x 7½ inch Spiral Rib Pipe

Span x Rise (inch)[a]	Equiv Diam. (inch)	Min. Nominal Thickness (inch)	Min. Cover (feet)	Max. Cover (feet)
20 x 16	18	0.064	1.6	15
23 x 19	21	0.064	1.7	14
27 x 21	24	0.064	1.8	13
33 x 26	30	0.064	1.8	13
40 x 31	36	0.064	1.9	13
46 x 36	42	0.064	1.8	13
53 x 41	48	0.064[b]	1.9	13
60 x 46	54	0.079	1.3	20
66 x 51	60	0.079[b]	1.3	20
73 x 55	66	0.109	1.3	20
81 x 59	72	0.109[b]	1.5	16
87 x 63	78	0.138	1.5	16
95 x 67	84	0.138	1.5	16
103 x 71	90	0.138[b]	1.5	16

(a) ASTM A760 makes provisions for two additional sizes: 112 x 75 inch and 117 x 79 inch.

(b) Trench installation only. Embankment installations may be used for the heavier gauges.

Section 910. Geosynthetics

910.01. General Requirements

Geosynthetics must be composed of long chain synthetic fiber of at least 85% (by weight) polyolefins or polyesters. Geosynthetics must be capable of resisting degradation from chemicals, mildew, rot, and ultraviolet (UV) light.

Deliver and store geosynthetics in packaging capable of resisting UV radiation, contaminants, and moisture. Label each unit of material with product information including supplier and lot identification. Do not expose geosynthetics to direct sunlight for prolonged periods. Repair or replace damaged geosynthetics at no additional cost to the Department.

910.02. Testing

Geosynthetic testing will be in accordance with the specified ASTM or Department methods, as modified by this section.

Geosynthetics must meet the physical property requirements shown in Tables 910-1 and 910-2. The directional property values listed in Table 910-1 specify values for the weaker principal direction.

910.03. Geotextiles

Geotextiles are flexible, permeable fabrics, consisting of synthetic fibers or yarns oriented into a dimensionally stable network. Woven geotextiles must have sealed or selvaged edges to prevent raveling.

A. **Geotextile Blanket.** Geotextile for filtration applications, including trench lining, ditch lining, streambed protection, pipe wrap, joint wrap, drainhole and weephole filter, granular blanket separation, and filter bags must be non-woven and meet the requirements shown in Table 910-1 for geotextile blanket.

B. **Geotextile Liner.** Geotextile for erosion control in riprap and similar applications must be non-woven and meet the requirements shown in Table 910-1 for geotextile liner. Geotextile for use with heavy riprap must be non-woven and meet the requirements shown in Table 910-1 for heavy geotextile liner.

C. **Geotextile Separator.** Geotextile used to prevent intermixing of dissimilar aggregate or soil layers must meet the requirements shown in Table 910-1 for geotextile separator. Geotextiles separators with grab tensile elongation-at-break less than 50% must meet the requirements shown in Table 910-1 for woven geotextile separator. Geotextiles with grab tensile elongation-at-break equal to or greater than 50% must meet the strength requirements shown in Table 910-1 for non-woven geotextile separator.

D. **Stabilization Geotextile.** Geotextile used to prevent intermixing of soft subgrade and subbase materials must meet the requirements shown in Table 910-1 for stabilization geotextile.

Stabilization geotextile with grab tensile elongation-at-break less than 50% must meet the requirements shown in Table 910-1 for woven stabilization geotextile. Geotextiles with grab tensile elongation-at-break equal to or greater than 50% must meet the strength requirements shown in Table 910-1 for non-woven stabilization geotextile.

910.04. Silt Fence Geotextile

Select geotextile for fabricating silt fence from the Qualified Products List. Geotextile for silt fence must have a nominal height of 3 feet and must meet the requirements shown in Table 910-1 for silt fence. Geotextile for silt fence must have a retained strength of at least 70% after 500 hours of UV exposure when tested in accordance with ASTM D4355/D4355M. Fabricate silt fence according to subsection 916.02.

910.05. Drainage Geocomposites

Drainage geocomposites must meet the requirements shown in Table 910-1 and this subsection.

Prefabricated geocomposites for drainage applications must consist of a geotextile bonded to or wrapped around a polymer core having corrugated, dimpled, tubular, or net (mesh) configurations. Geocomposites must have sufficient flexibility and durability to withstand installation, handling, and permanent loading stresses.

Fittings for geocomposite installations must be manufactured by the geocomposite manufacturer or meet the published specifications of the geocomposite manufacturer. Provide tape used to seal connections with adhesive resistant to moisture and organic growth and recommended by the manufacturer for underground service conditions.

Obtain the Engineer’s approval for all components of the geocomposite system before installation.

A. **Wall Drain.** Wall drains for single-direction cross-planar flow must consist of an impermeable polymer core with geotextile bonded to one side. The geocomposite must have a minimum crush strength of 4,000 pounds per square foot at no more than 18% deformation when tested according to MTM 411.

B. **Geocomposite Net.** The Engineer may allow geocomposite net consisting of geotextile blanket bonded to both sides of a mesh core as an alternative to open-graded aggregate drainage layers.

The Engineer will approve the geocomposite net based on durability, drainage capacity, crush resistance, tensile strength, and thickness.

910.06. Road Grade Biaxial Geogrid

The geogrid must be a regular grid structure and must have aperture geometry and rib and junction cross-section sufficient to permit significant mechanical interlock with the material being reinforced. The geogrid must have significant dimensional stability through all ribs and junctions of the grid structure. The geogrid must maintain its reinforcement and interlock capabilities under repeated dynamic loads while in service. The geogrid must also be resistant to UV degradation, to damage under normal construction practices, and to all forms of biological or chemical degradation normally encountered in highway construction.

The geogrid must be composed of polypropylene, HDPE, or polyester virgin resins. The protective coatings of polyester geogrids must contain less than 5% filler content. Repair damaged coating prior to backfilling. The geogrid must meet the physical property requirements of Table 910-2.

Table 910-1:
Physical Requirements for Geotextiles

	Property				
	Grab Tensile Strength (min.) (lb)	Trapezoid Tear Strength (min.) (lb)	Puncture Strength (min.) (lb)	Permittivity (min.) (per second)	Apparent Opening Size (max.) (mm)
	Test Method				
Geotextile Category	ASTM D4632/ D4632M	ASTM D4533/ D4533M	ASTM D6241	ASTM D4491/ D4491M	ASTM D4751
Geotextile blanket[(a)]	120	45	230	0.5	0.21
Geotextile liner	200	75	440	0.5	0.21
Heavy geotextile liner	270	100	620	0.5	0.21
Woven geotextile separator	270	100	620	0.05	0.425
Non-woven geotextile separator	200	75	440	0.5	0.425
Woven stabilization geotextile	270	100	620	0.05	0.50
Non-woven stabilization geotextile	270	100	620	0.5	0.50
Silt fence	100[(b)]	45	—	0.1	0.60
Drainage geocomposites	200	75	440	0.5	0.21

(a) For pipe wrap where backfill around the pipe meets granular material Class IIAA requirements; geotextiles, including knitted polyester sock, which meet the following minimum requirements in the applied condition, are permitted: mass/unit area: 3.0 oz/yd²; Mullen burst strength: 100 psi; maximum apparent opening size must be 0.30 mm for pavement and foundation underdrains and 0.60 mm in other areas. The fluid displacement rate for the Mullen burst test equipment must be 170 mL/min ± 5 mL/min. Subtract tare strength from the ultimate burst strength as specified in ASTM D3786/D3786M.

(b) Elongation at the specified grab tensile strength no greater than 40% for silt fence.

Table 910-2:
Physical Requirements for Road Grade Biaxial Geogrid

Property	Minimum Value (except where noted below)	Test Method
Interlock open area	60%	U.S. Army Corps of Engineers[a]
Ultimate strength		ASTM D6637/D6637M[b]
MD[c]	1200 lb/ft	
MD[c]	1950 lb/ft	
Individual junction strength		ASTM D7737/D7737M
MD[c]	130 lb	
CMD[c]	170 lb	
Tensile modulus (2%)		ASTM D6637/D6637M[b]
MD[c]	18,000 lb/ft	
CMD[c]	30,000 lb/ft	
Aperture size		Measured
MD[c]	1.0 inch (nominal value)	
CMD[c]	1.3 inch (nominal value)	

(a) Percent open area measured without magnification by means of U.S. Army Corps of Engineers method as specified in CW 02215, Civil Works Construction Guide Specification for Plastic Filter Fabric (1977).

(b) Ultimate strength and tensile modulus at 2% elongation measured by means of ASTM D6637/D6637M. No offset allowances or specimen pretensioning are made in calculating tensile modulus.

(c) MD (machine direction) and CMD (cross-machine direction) refer to the principal directions of the manufacturing process.

Section 911. Water

911.01. General Requirements

Water must be clean, clear, and free of oil, salt, acid, alkali, organic matter, chlorides, or other deleterious material.

911.02. Turf, Turf Establishment, and Landscape Plants

Provide water from a potable or non-potable water source approved by the Engineer. Use irrigation-quality water that is free of elements harmful to plant growth.

911.03. Mixing or Curing Concrete, Mortar, Grout, and Other Cementitious Products

Potable water from sources approved by the Michigan Department of Public Health or equivalent approved by the Engineer is acceptable without testing.

Surface water from sources including, but not limited to, ditches, lakes, ponds, quarries, rivers, streams, wetlands, and other similar untreated sources is prohibited for mixing or curing concrete, mortar, grout, and other cementitious products. Stationary concrete batch plants may use surface water if the facility has established at least a 5-year history of producing consistent concrete products meeting the required specifications. Stationary concrete batch plants using surface water are required to meet the non-potable water sampling and testing requirements.

Non-potable must meet the requirements of Table 911-1. Do not use non-potable water unless approved by the Engineer.

Test non-potable water prior to use, once per month (once per 6 months for stationary concrete batch plants) thereafter, and at any time the water source may be deemed out of compliance due to changing site conditions as determined by the Engineer. Water must be sampled and tested by a qualified independent testing laboratory having no association with the supply or production of materials produced by that concrete facility at the expense of the Contractor. Submit test results to the Engineer for approval prior to use and within 3 days of completion of testing. If water fails to meet the requirements of this specification, immediately suspend use of water source, bring water into compliance, and retest. Do not resume use of the water source until approved by the Engineer.

Table 911-1:
Non-Potable Water Requirements

Property	Test Method	Specification
Total solids	ASTM C1602	≤0.30%
Total organic content / carbon	SM 2540 E	≤0.05%
Alkalinity-acidity (pH)	ASTM D1067	5.5–8.5
Chloride (Cl-)	ASTM D512	≤0.05%
Time of setting	ASTM C1602	–1:00 hour to +1:30 hours of control
7-day compressive strength	ASTM C1602	≥90% of control

Section 913. Masonry Units

913.01. General Requirements

Clay brick, concrete brick, concrete block, salvaged paving brick, precast reinforced concrete units, and structural tile for masonry structures must meet the requirements of this section.

913.02. Testing

Testing will be in accordance with the specified ASTM or AASHTO method as modified by this section.

913.03. Brick

A. **Brick Dimensions.** Brick must meet the following nominal size limitations:

1. Depth – 2 to 2½ inches;
2. Width – 3½ to 3¾ inches; and
3. Length – 7½ to 8 inches.

Brick for a single structure must be of one nominal size and must not vary from the manufacturer's specified standard dimensions by more than ±⅛ inch in any dimension. However, clay brick may vary in length by ±¼ inch, and up to 2% of the contract's clay brick quantity may exceed the dimensional tolerances.

B. **Clay Brick.** Clay brick to construct manholes, catch basins, and similar structures must meet the requirements of ASTM C32 for Grade MS.

Recessed or cored brick is acceptable.

Salvaged paving brick meeting the requirements of this section is acceptable.

C. **Concrete Brick.** Concrete brick must meet the requirements of ASTM C55 for concrete building brick.

Recessed or cored brick is acceptable.

D. **Sand-Lime Brick.** Sand-lime brick for masonry structures must meet the requirements of ASTM C73 for Grade SW and the following 5-hour boiling test water absorption requirements:

1. Average of five bricks – 18% maximum; and
2. Individual brick – 20% maximum.

913.04. Concrete Masonry Units for Structures Other than Drainage Structures

A. **Load-Bearing Units.** Hollow, load-bearing, concrete masonry units must meet the requirements of ASTM C90, Normal Weight.

B. **Non-Load-Bearing Units.** Hollow, non-load bearing, concrete masonry units must meet the requirements of ASTM C129, Normal Weight.

913.05. Concrete Block for Drainage Structures

Concrete blocks for manholes, catch basins, and inlets must meet the requirements of ASTM C139 except as modified by this subsection.

A. **Shape.** Block must be solid with parallel inside and outside surfaces, curved to the required radii, and must have a groove or other Department-approved joint at the ends.

B. **Size.** The block manufacturer will select the nominal block dimensions for length and height. Blocks must have a nominal width of 6, 8, or 12 inches, ±3%, as shown on the plans.

Where standard plans call for 12-inch-thick drainage structure walls, the Contractor may use two 6-inch-wide blocks to meet the required width. Blocks must be designed for length so that only full or half-length blocks are required to lay the circular wall of any one course.

The shape of blocks for use in the cones or tops of manholes or other structures must allow for constructing the structure as shown on the plans with inside and outside joints not to exceed ¼ inch in thickness.

913.06. Precast Reinforced Concrete Units for Drainage Structures

Circular precast concrete units with circular reinforcement for tops, risers, and sump bases for manholes, catch basins, and inlets must meet the requirements of AASHTO M199 and the following additions and exceptions:

A. Units must have the internal diameter shown on the plans and must accept standard covers.

B. The joint with the vertical wall of the structure must be the same design as the joints in the circular pipe sections to allow a uniform bearing on the full wall thickness of the pipe.

C. Construct openings for pipe inlets or outlets in the riser sections of drainage structures by blocking out the openings when casting the sections by scribing the openings in the green concrete and removing the green concrete from the openings or by drilling out the openings from cured concrete with a water-cooled diamond bit.

D. Openings in the riser sections must be 3 inches larger than the OD of the inlet or outlet pipe. The interior spacing between openings in a riser section must be at least 12 inches.

E. Obtain the Engineer's approval for the design of units for structure tops and for the design of sump risers with base units. Request approval for sump riser and base units used together.

913.07. Precast Concrete Bases for Drainage Structures

Precast concrete bases for drainage structures for sewers less than 48 inches in diameter must be cast with Grade 3000 or Grade 4000 concrete.

913.08. Structural Tile

A. **Load-Bearing Units.** Structural clay load-bearing tile must meet the requirements of ASTM C34 for Grade LBX.

B. **Non-Load-Bearing Units.** Structural clay non-load-bearing tile must meet the requirements of ASTM C56.

913.09. Precast Concrete Slope Paving Blocks

Blocks must have a compressive strength of at least 2,500 psi for an average of three units with no individual block having a compressive strength of less than 2,000 psi. The average water absorption of three units must be no greater than 10 pounds per cubic foot.

The Department will sample and test precast concrete slope paving blocks in accordance with ASTM C140/C140M with the following exceptions:

A. Test 4 by 4 inch compression test specimens sawn from precast concrete slope paving block units. The specimens will be tested with the load applied in the direction of the thickness of the unit.

B. Determine water absorption using half of the unit used for the compression test specimen.

Section 914. Joint and Waterproofing Materials

914.01. General Requirements

Joint and waterproofing materials for use in concrete construction must meet the requirements of this section.

914.02. Testing

Steel joint material testing must be in accordance with ASTM E8/E8M or ASTM A370 and the ASTM specifications applicable to the specific material.

Other joint and waterproofing material testing must be in accordance with the specified ASTM, AASHTO, or Department methods, as modified by this section.

914.03. Joint Filler for Concrete Construction

Cut joint filler into the shape and to the dimensions shown on the plans. Joint filler must not deform or break due to twisting, bending, or handling when exposed to atmospheric conditions. For concrete pavements, punch holes in the fiber joint filler for load transfer bars in new concrete pavements, as shown on the plans.

A. **Fiber Joint Filler.** Fiber joint filler must meet the requirements of ASTM D1751.

B. **Recycled Rubber Joint Filler.** Recycled rubber joint filler must meet the requirements of ASTM D1751 except that the minimum asphalt content does not apply.

C. **Closed-Cell Polypropylene Foam.** Semi-rigid, closed-cell polypropylene foam joint filler must meet the requirements of ASTM D8139.

914.04. Joint and Crack Sealants for Construction

A. **Hot-Poured Joint and Crack Sealant.** Hot-poured joint and crack sealant must meet the requirements of the Qualified Products List for Hot-Poured, Extra Low Modulus, Joint and Crack Sealant.

   Material containers must be legibly marked with a non-fading, weather-resistant ink or paint. Include the manufacturer’s name or trade name, batch number, recommended pouring temperature, and the maximum safe heating temperature on the label.

B. **Backer Rod for Use with Hot-Poured Joint Sealant.** Backer rod for use with a hot-poured joint sealant must be solid, round, heat-resistant, closed-cell, cross-linked PE foam meeting the requirements of ASTM D5249 for Type I.

914.05. Joint Spall Repair Materials

Select joint spall repair material according to the contract.

914.06. Epoxy Resin Adhesive

Epoxy resin adhesive must be capable of being injected into, and flow along, a crack 0.005 inch wide. Select epoxy-resin adhesive from the Qualified Products List.

Use a fast-setting grout or fast-set temporary seal as recommended by the epoxy resin adhesive manufacturer.

914.07. Dowel Bars for Transverse Expansion and Contraction Joints

Dowel bars must meet the requirements of ASTM A1078/A1078M.

Provide dowel baskets from a Department-approved source. Secure the dowel bars into the baskets by welding or other mechanical method so the dowels maintain alignment during and after concrete placement.

The ends of dowel bars for expansion and contraction joints must be saw cut or sheared and free of burrs. If dowel bars are sheared, ensure that the ends remain round and do not deform. Dowel bars that are not free of burrs, deformation, or other surface defects will be rejected. Protect dowel bars during handling and storage according to ASTM A1078/A1078M.

A. **Coatings for Dowel Bars.** If required, provide dowel bars coated with an epoxy powder coating meeting the requirements of the Qualified Products List. The epoxy powder must be pigmented purple or gray.

   The Engineer may sample and test dowel bars for average coating thickness, and check for chips, cracks, or other damage to the coating and for the presence of a bond breaker, if required, before installation in the concrete construction. Dowels with coatings not meeting the thickness requirements or dowels with coating damage will be rejected.

   Epoxy-coated dowel bars must have an average coating thickness of not less than 0.010 inch or more than 0.014 inch on any bar, with individual determinations on a single bar within 0.004 inch of the average. Coating is not required on the end faces of the bars or on the cylindrical surface within 3 inches of the end fixed in the supporting basket by welding or other mechanical means.

   To prevent bonding to concrete, epoxy-coated dowels must be coated with an asphalt material meeting the requirements of MC 70 or RC 250, as specified in subsection 904.03.B, or an alternative bond-release agent selected from the Qualified Products List. Bond-release agents must provide a pull-out shear bond stress of the dowel bar no greater than

60 psi for initial and final movement of the dowel from the concrete specimen.

The Contractor or supplier may apply asphaltic coatings to the dowel bar and the dowel basket assembly. The manufacturer must apply the alternative bond-release agents to the dowel bar and the dowel basket assembly.

B. **Dowel Bar Expansion Caps.** Dowel bars for expansion joints must include metal or plastic expansion caps as shown on the plans and approved by the Engineer. Expansion caps must be sized to provide a slip fit onto the coated bar.

Expansion caps must have a uniform diameter for a length of at least 4 inches and must include a stop to ensure that the end of the cap remains at least 1 inch away from the end of the dowel bar during concrete placement. Fabricate metal expansion caps from at least 28-gauge sheet steel and close at the sides and end by crimping. Plastic expansion caps must be one piece with a uniform thickness of at least 1/16 inch, entirely closed on the end.

914.08. Devices for Transverse End-of-Pour Joints

Use straight steel tie bar devices for end-of-pour joints.

Straight tie bars for end-of-pour joints must consist of bars of the diameter and length shown on the plans meeting the requirements of ASTM A615/A615M, ASTM A706/A706M, or ASTM A996/A996M (Type R or Type A). Epoxy coat straight tie bars as specified in subsection 905.03.C except that the application of the epoxy coating within 4 inches of each end of the tie bar or the repair of damage to the coating within 4 inches of each end of the bar is not required.

914.09. Lane Ties for Longitudinal Pavement Joints

A. **Straight Tie Bars.** Straight tie bars for longitudinal pavement joints must consist of bars of the diameter and length shown on the plans meeting the requirements of ASTM A615/A615M, ASTM A706/A706M, or ASTM A996/A996M (Type R or Type A). Epoxy coat straight tie bars as specified in subsection 905.03.C except that the application of the epoxy coating within 4 inches of each end of the tie bar or the repair of damage to the coating within 4 inches of each end of the bar is not required.

B. **Bent Tie Bars for Bulkhead Joints.** Bent tie bars for bulkhead joints must consist of bars of the diameter and length shown on the plans. The tie bars must have a yield strength of at least 40,000 psi and be capable of withstanding bending to a 90° angle, re-straightening, and then

withstanding the pull-out test requirements specified in subsection 602.03.F.

Epoxy coat bent tie bars as specified in subsection 905.03.C except that the application of the epoxy coating within 4 inches of each end of the tie bar or the repair of damage to the coating within 4 inches of each end of the bar is not required.

914.10. Structure Expansion Anchors and Bolts

Select expansion anchors from the Qualified Products List in the sizes and shapes shown on the plans. Bolts for flush-type anchors must meet the requirements of ASTM A307 for Grade A.

914.11. Preformed Waterproofing Membranes and Joint Waterproofing

Select preformed waterproofing fabric system, including the manufacturer's recommended primer, from the Qualified Products List.

914.12. Elastomeric Bearings and Pads

A. **Bearings.** Elastomeric bearings must meet the requirements of the *AASHTO LRFD Bridge Construction Specifications*, Subsection 18.2, "Elastomeric Bearings," for 100% virgin polychloroprene (neoprene) or polyisoprene (natural rubber) bearings and must be classified as being of low-temperature Grade 4 or 5.

Laminated bearings must have a shear modulus of 100 psi ±15 psi. Plain bearings must have a shear modulus of 200 psi ±30 psi. Rolled steel sheet laminates must meet the requirements of ASTM A36/A36M or ASTM A1011/A1011M, Grade 36, Grade 40, or Grade 50. Blast-clean the surfaces of the laminates where elastomers are to be bonded.

Elastomeric bearings must be tested and accepted in accordance with Section 8 of AASHTO M251 except that the definition of a lot specified in Subsection 8.2 of AASHTO M251 is revised as follows: Sampling, testing, and acceptance consideration will be made on a lot basis. A lot of bearings must be considered to be a group of bearings that are manufactured over a 4-month period from the same elastomer recipe, cured under the same conditions, and type (plain, fabric laminated, or steel-laminated).

B. **Leveling Pads.** Elastomeric leveling pads (1/8 inch thick or as specified in the contract) must meet the requirements of the *AASHTO LRFD Bridge Construction Specifications*, Subsection 18.2, "Elastomeric Bearings," for 100% virgin polychloroprene (neoprene) or polyisoprene (natural rubber) bearings and must be classified as being of low-temperature Grade 3. Leveling pads must be plain elastomer and have a hardness between

50 and 70 on the Shore A scale. Provide certification to the Engineer that elastomeric leveling pads conform to this subsection.

Elastomeric leveling pads must be tested and accepted in accordance with Appendix X1 of AASHTO M251 except that a lot is defined to be material that is manufactured from the same elastomer recipe and cured under the same conditions and tested no less than once per year.

914.13. Non-Metallic Washers

Washers used as spacers between pin plates and link plates must be HDPE, non-metallic washers meeting the requirements of ASTM D4976, Group 2, Class 4, Grade 4.

Section 917. Turf and Landscaping Materials

917.01. General Requirements

Nursery stock, seed, sod, mulching material, and chemical fertilizer nutrients must meet the requirements of this section. Provide documentation of inspection for plant diseases and insect infestation in accordance with state and federal laws.

917.02. Testing

The Engineer will require visual inspection or other acceptance tests of landscaping material as specified in this section or the MDOT's *Materials Quality Assurance Manual*.

917.03. Nursery Stock

Nursery stock must come from nurseries in Zone 4 or Zone 5 of the 2012 United States Department of Agriculture (USDA) Hardiness Zone Map for landscaping in Michigan's Lower Peninsula.

Nursery stock for landscaping in Michigan's Upper Peninsula must come from nurseries in Zone 3 or Zone 4.

Nurseries in Zone 6 of the Upper Great Lakes Region are allowed as follows:

A. At or north of latitude 40 degrees North;

B. Zone 6b includes only nurseries in counties that border the Great Lakes; and

C. Zone 6 plants are not acceptable for use in Upper Peninsula or in Lower Peninsula counties north of US-10 except for counties bordering Lake Michigan.

Nursery stock must meet the requirements of ANSI Z 60.1.

Nursery stock must be true to the type and name specified by the American Joint Committee on Horticultural Nomenclature's *Standardized Plant Names*. Label each plant type with the size, species, and variety. Include the common and scientific names on the label. Provide first-class quality stock with well-developed branch systems and vigorous, healthy root systems. Ensure uniform and straight tree trunks. Nursery stock grown in sandy soils or any damaged, diseased, under-developed, or infected plant material will be rejected. Provide trees, ornamentals, and shrubs as noted on the plans.

Notify the Engineer a minimum of 24 hours before stock delivery. Provide an invoice showing plant sizes, species, and varieties for each shipment. Plants will not be accepted until the stock is delivered and inspected at the project.

The Engineer may examine plants at the nursery by removing soil from the root systems of balled or container grown plants or by digging in the nursery row. The Department will not pay for plants that fail the Engineer's inspection.

A. **Deciduous Shade Trees.** Deciduous shade trees must be straight and symmetrical with a persistent, central main leader. The crown must be in proportion to the total height of the tree.

   Clumps must have at least two stems originating from a common base at the groundline.

B. **Small Trees, Ornamentals, and Shrubs.** Small trees, ornamentals, and shrubs must be well formed with a crown typical of each species or variety. Pruning, shearing, or sculpting plants to meet the sizes shown on the plans is not allowed.

C. **Evergreen Trees.** Evergreen trees must be typical of the species and not sheared or color treated. Do not use evergreen trees grown for Christmas trees. Antitranspirant protection for evergreen trees is allowed.

D. **Vines, Ground Cover, and Herbaceous Ornamental Plants.** Plants must be in individual containers, at least 1 year old, grown in pots long enough to ensure root growth capable of holding soil in place and retaining the container shape when removed from the pot. Vines must have at least four runners 1½ feet long. Leaf and stem structure of ground cover plants must be proportional to the root systems and typical of species or variety. Provide herbaceous plants in a heathy and vigorous growing condition.

917.04. Balling Material

Use untreated burlap as balling material. Do not use synthetic balling materials such as nylon or plastic.

917.05. Bracing and Guying Materials

A. **Wire.** For trees less than 4 inches in diameter, provide No. 11 galvanized steel guy wire. For trees with a diameter greater than 4 inches, provide No. 9 galvanized steel guy wire. Provide new wire free of bends and kinks.

B. **Hose.** Provide ¾-inch reinforced rubber garden hose or steam hose.

C. **Stakes.** Provide green metal T-section posts without anchor plates for bracing trees. For shade trees, the minimum post length is 8 feet. For evergreen trees, the minimum post length is 6 feet.

Provide nominal 2- by 4-inch stock stakes 24 inches long for guying plants. Stakes must be beveled on two or four sides to provide a point on one end.

917.06. Topsoil

The Engineer will review the topsoil testing report to determine whether it meets the organic matter, pH, gradation, and nutrient levels as stated in Table 917-1. Ensure that the topsoil is contamination-free and clean at the source prior to transport to the project site. Obtain the Engineer's approval for salvaged topsoil prior to use. Topsoil must meet the following requirements:

A. **Testing Reports.** Reports must contain at a minimum the following tests and the recommendation from the laboratory for amending the soil.

1. Mechanical gradation (particle size analysis);
2. Sand/Silt/clay content determined by hydrometer test of soil passing the No. 200 sieve;
3. Organic matter determined by an ash burn test or Walkley/Black test; and
4. Chemical analysis for nitrate nitrogen, ammonium nitrogen, phosphorus, potassium, calcium, aluminum, lime requirements, and acidity (pH).

Table 917-1:
Topsoil Requirements

Requirement	Loam	Sandy Loam	Silty Loam	Clay Loam	Test Method
Passing ¾-inch sieve	100%	100%	100%	100%	ASTM D6913
Passing No. 4 sieve	>85%	>95%	>90%	>90%	ASTM D6913
Clay	10–30%	0–20%	0–25%	25–40%	ASTM D6913
Silt	30–50%	0–30%	50–90%	15–55%	ASTM D6913
Sand	25–65%	45–85%	0–50%	20–50%	ASTM D6913
Organic matter	3–10%	3–10%	3–10%	3–10%	ASTM D2974
pH	5.5–7.5	5.5–7.5	5.5–7.5	5.5–7.5	ASTM G51

917.07. Compost

The Engineer will review the compost test results to determine whether they meet the U.S. Composting Council's requirements. The Engineer will also visually inspect and approve the compost at the composting site for physical contaminants.

Compost must be mature, stabilized, humus like, and dark brown or black compost derived from the aerobic decomposition of yard clippings or other compostable materials as defined in the Natural Resources and Environmental Protection Act, Part 115, Solid Waste Management, MCL 324.11501 et seq., and federal laws. Compost must be certified through the US Composting Council's Seal of Testing Assurance Program and meet the following requirements:

A. Must be capable of supporting plant growth;

B. Must be free of objectionable odor, plastic, glass, metal, and other physical contaminants;

C. Must not contain viable weed seeds or other plant parts capable of reproducing with the exception of airborne weed species; and

D. Must not produce visible free water or dust during handling.

917.08. Peat Moss

Peat moss must consist of finely shredded sphagnum or fibrous peat moss of a Department-approved commercial grade, free of woody substance.

917.09. Fertilizers

Provide standard, commercial, packaged, or bulk product fertilizers in granular or liquid form. Each container of packaged fertilizer must be marked with the content analysis showing the minimum percentages of total nitrogen, available phosphoric acid, and soluble potash. If providing bulk fertilizer, provide an invoice with each shipment indicating the minimum percentages of total nitrogen, available phosphoric acid, and soluble potash.

A. **Landscape Fertilizers**

1. **Planting Fertilizers.** For mixing with peat moss and topsoil, provide ready-mixed granular fertilizer containing equal amounts of phosphorus and potassium by weight. Each cubic yard of prepared soil must contain chemical fertilizer to provide 1 pound of available phosphorus and 1 pound of available soluble potassium.

2. **Watering Fertilizers.** For application during watering, provide water soluble, nitrogen-enriched fertilizer containing 8.3 pounds of available nitrogen per 1,000 gallons of water.

B. **Seeding and Sodding Fertilizers.** Fertilizers in each class must contain a water-insoluble and water-soluble component.

1. **Class A.** Provide and apply as specified by this subsection and as indicated by soil tests:

a. **Water-Insoluble Fertilizer.** Apply 32 pounds of water-insoluble nitrogen per acre (e.g., 128 pounds of ureaform, 115 pounds of isobutylidene diurea). Provide the water-insoluble nitrogen from ureaformaldehydes, coarse grade isobutylidene diurea, or both.

b. **Water-Soluble Fertilizer.** Apply 48 pounds of nitrogen, phosphorous, and potassium nutrient per acre (e.g., 253 pounds of 19-19-19, 400 pounds of 12-12-12). Provide water-soluble fertilizer containing a 1:1:1 ratio of nitrogen, phosphorous, and potassium. Ensure that the fertilizer components include urea, diammonium phosphate, and potassium chloride.

2. **Class B.** Provide and apply as specified by this subsection and as indicated by soil tests:

a. **Water-Insoluble Fertilizer.** Apply 32 pounds of water-insoluble nitrogen per acre. Provide the water-insoluble nitrogen from ureaformaldehydes, coarse grade isobutylidene diurea, or both.

b. **Water-Soluble Fertilizer.** Apply nitrogen at a rate of 48 pounds of nutrient per acre and 40 pounds of potassium per acre. Ensure that fertilizer components include urea and potassium chloride.

3. **Class C.** Provide and apply as specified by this subsection and as indicated by soil tests:

a. **Water-Insoluble Fertilizer.** Apply 32 pounds of water-insoluble nitrogen per acre. Provide water-insoluble nitrogen from ureaformaldehydes, coarse grade isobutylidene diurea, or both.

b. **Water-Soluble Fertilizer.** Apply nitrogen at a rate of 48 pounds of nutrient per acre. Ensure that the fertilizer components include urea.

917.10. Water

Use water that meets the requirements of section 911.

917.11. Seed

Provide the required certified seed mixture as specified in Table 917-2. Select each species of seed from the Qualified Products List. Supply seed in durable bags with a tag marked by the manufacturer and supplier of the blended mix showing the species and variety name, lot number, net weight of contents, purity, and germination.

Table 917-2:
Seed Mixtures

Species	Minimum Purity (%)	Germination (%)	Seed Mixture Proportions (% by weight)							
			TDS	THV	TUF	TGM	THM	CR	TSM 6–24 months	TSM >24 months
Kentucky blue grass	98	85	5	15	10	10	30	—	—	—
Perennial ryegrass	96	85	25	30	20	20	20	—	50	50
Hard fescue	97	85	25	—	20	30	—	—	—	—
Creeping red fescue	97	85	45	45	40	40	50	—	—	—
Fults salt grass	98	85	—	10	10	—	—	—	—	—
Cereal rye	85	85	—	—	—	—	—	100	—	—
Spring oats	85	85	—	—	—	—	—	—	50	50

CR = cereal rye
TDS = turf dry sandy
TGM = turf medium to heavy soil
THM = turf loamy to heavy
THV = turf heavy soil
TSM = temporary seeding (months)
TUF = turf urban freeway

Seed must be tested in accordance with the *AOSA [Association of Official Seed Analysts] Rules for Testing Seeds*. The Engineer will evaluate deficiencies below the percentage required for purity and germination to determine acceptability.

917.12. Sod

Provide sod consisting of a densely rooted blend of at least two bluegrass varieties with at least 30% creeping red fescue content, free of weeds, and grown on the same or similar soil as the topsoil on the project. Obtain the Engineer's approval of the sod in the sod field before harvesting. Before cutting the sod, mow the grass to 3 to 4 inches above the ground surface.

Cut the sod from ½ to ¾ inch thick. If cutting sod into strips, cut in small uniform units of approximately 10 square feet per roll to ensure ease of handling of the sod without tearing or breaking. The sod may be cut, transported, and laid in large rolls with machinery designed for that purpose.

A. **Pegs for Sodding.** Provide pegs of sound wood, at least 10 inches long, with a cross-sectional area of at least 0.75 square inch for pegging sod. Use longer pegs in sandy or similar soils.

917.13. Mulching Materials for Nursery Stock

A. **Shredded Bark.** Provide shredded hardwood bark mulch consisting of tree bark stripped and shredded from saw logs with a debarking machine. Shredded hardwood bark mulch must be capable of passing through a conventional mulch blower. Do not use wood chips or recycled construction material.

917.14. Mulch for Seed

A. **Loose Mulch.** Provide clean, undamaged, and rot-free straw in an air-dry condition for loose mulch. Loose mulch must be free of weed seeds and other deleterious material.

B. **Turf Mulch Blankets.** Select turf mulch blankets from the Qualified Products List. Anchor according to the manufacturer's specifications. No metal stakes or staples are allowed.

1. **High-Velocity Mulch Blankets.** High-velocity mulch blankets must have net covering on two sides. The net must meet the requirements of subsection 917.14.D and be capable of reinforcing the blanket to prevent damage during shipping, handling, and installation.

a. **High-Velocity Excelsior Mulch Blankets.** Provide high-velocity excelsior mulch blankets that meet the following requirements:

i. Blanket must consist of a uniform layer of interlocking excelsior fibers cut from sound, green timber;

ii. The average roll weight for an entire shipment must be 12 ounces per square yard ±10%;

iii. Blankets must be shipped in tightly compressed rolls; and

iv. Each roll must have the roll weight and the manufacturer's name written or stenciled on the roll wrapper or on an attached tag.

b. **High-Velocity Straw Mulch Blankets.** Provide high-velocity straw mulch blankets that meet the following requirements:

i. Blankets must consist of a uniform layer of clean wheat straw that is free of weeds and weed seed;

ii. When dry, the blankets must weigh 8 ounces per square yard ±10%;

iii. The straw and net must be stitched together to create a uniform mat;

iv. Blankets must be shipped in tightly compressed rolls; and

v. Each roll must have the roll weight and the manufacturer's name written or stenciled on the roll wrapper or on an attached tag.

2. **Mulch Blankets**

a. **Excelsior Mulch Blankets.** Provide excelsior mulch blankets meeting the requirements of high-velocity excelsior mulch blankets except that the blankets must weigh from 8 to 12 ounces per square yard and have netting on one side.

b. **Straw Mulch Blankets.** Provide straw mulch blankets meeting the requirements of high-velocity straw mulch blankets except that the blankets must have netting on one side.

C. **Mulch Anchoring.** Select mulch anchoring material from the Qualified Products List.

1. **Latex-Base.** Provide latex-base mulch-anchoring material composed of 48% styrene, 50% butadiene, and 2% additive by weight. The mulch-anchoring material must contain from 42.0 to 46.0% solids and a pH, as shipped, from 8.5 to 10.0. Protect the emulsion from freezing and prolonged exposure to sunlight.

2. **Recycled Newsprint.** Provide recycled newsprint mulch consisting of specially prepared, biodegradable, shredded, recycled newsprint fibers. The recycled newsprint fiber must:

    a. Have a moisture content (total weight) no greater than 12%;

    b. Have a high-grade newsprint content of at least 96% by weight (oven-dry);

    c. Include tackifier content from 1.5 to 3% by weight;

    d. Have a water-holding capacity of at least 32 ounces per 3.5 ounces of fiber;

    e. Contain a wetting agent and a defoaming agent; and

    f. Contain a nontoxic bright green or blue dyestuff that adheres to the fiber to minimize leaching of the color after application.

3. **Wood Fiber.** Provide specially prepared, biodegradable, air-dried, virgin wood fibers manufactured from 100% whole wood chips. Do not use recycled materials. The wood fiber must:

    a. Have a moisture content (total weight) no greater than 12%;

    b. Have an organic wood fiber content of at least 95% by weight (oven-dry);

    c. Include tackifier content from 3 to 5% by weight;

    d. Have a water-holding capacity of at least 35 ounces per 3.5 ounces of fiber;

    e. Be dyed with a green or blue biodegradable dye; and

    f. Contain no growth- or germination-inhibiting materials.

4. **Guar Gum.** Provide guar gum tackifiers consisting of at least 95% guar gum by weight with the remaining 5% by weight consisting of dispersing and crosslinking additives.

5. **Other Tackifiers.** Provide water-soluble natural vegetable gums, guar gums blended with gelling and hardening agents, or a water-soluble blend of hydrophilic polymers, viscosifiers, sticking aids, and other gums as tackifiers.

D. **Mulch Netting**

1. **Netting.** Provide mulch net with a mesh size from ½ by ½ inch to 1½ by 2 inches, formulated from or treated with a chemical that promotes the breakdown of the net within the first growing season

after placement. Mulch netting must be strong enough to hold the mulch in place and still deteriorate when exposed to sunlight.

2. **Net Anchors.** Provide wood or other biodegradable net anchors at least 6 inches in length. Do not use steel wire staples or pins to anchor mulch blankets or netting.

917.15. Weed Control

Provide herbicides registered for use on highway right-of-way by the Michigan Department of Agriculture & Rural Development and the United States Environmental Protection Agency. Obtain the Engineer's approval of herbicides prior to use. Do not use restricted-use herbicides.

917.16. Growth Preventive Material

Provide cut stump herbicide composed of the ingredients and nominal concentrations as appropriate.

A. Upland Location

1. 83% paraffin oil, surface active compounds, and coupling agents with blue colorant

   17% triclopyr, butoxyethyl ester

2. 82% paraffin oil, surface active compounds, and coupling agents with blue colorant

   15% triclopyr, butoxyethyl ester

   3% isopropylamine salt of imazapyr

B. Wetland or Aquatic Location

1. 100% triclopyr choline salt with blue colorant

Section 1004. Portland Cement Concrete Mixtures

1004.01. Description

Concrete must consist of a mixture specified by the grade of concrete of portland cement or blended portland cement; fine aggregate; intermediate aggregate, when required or permitted; coarse aggregate; water; and admixture, when required or permitted.

1004.02. Materials

Provide materials in accordance with the following:

Portland Cement 901
Slag Cement 901
Fly Ash 901
Coarse Aggregate 6A, 6AA, 6AAA, 26A, 29A, 17A 902
Intermediate Aggregate 902
Fine Aggregate 2NS, 2SS 902
Concrete Admixtures 903
Water 911

Select aggregates for the required grade of concrete in accordance with Table 1004-1.

Stone sand 2SS is not permitted in concrete exposed to vehicular traffic.

1004.03. General Requirements

A. **Mix Design and Documentation.** Design concrete mixtures meeting the requirements of Table 1004-1. Provide the grade of concrete for the section number reference application specified in Table 1004-1 or as specified in the contract. Concrete grades ending in HP signify high-performance concrete.

Variance requests must be submitted in writing and must include the mix design, JMF, and associated trial batch verification test data. Do not use a grade of concrete with a specified 28-day compressive strength different from what is designated for the application.

B. **Cementitious Materials Content.** Type III cement is not permitted.

Use combined weight of total cementitious materials when determining compliance with the water-cementitious ratio and cementitious material requirements.

All high-performance concrete requires 25 to 40% replacement of portland cement with supplementary cementitious materials (SCM). For all other grades of concrete, replacing portland cement with SCM is permitted. Unless otherwise specified in the contract, do not exceed a total of 40%

replacement by weight of portland cement with SCMs. Acceptable SCMs are listed in subsections 901.06, 901.07, and 901.08.

C. **Optimized Aggregate.** Optimized aggregate gradation is required for high-performance concrete and concrete mixtures that are placed using a pump. Concrete mixtures for tremie and drilled shaft applications do not require optimized aggregate gradation. Prepare the optimized aggregate gradation and perform process control according to the procedure for optimized aggregate gradation in the contract.

Aggregates for mixture requiring optimized aggregate gradation must meet the physical requirements specified in subsection 902.03.C. The physical requirements for aggregates used in concrete mixtures for all other applications are according to the contract.

When high-performance concrete is specified in the contract, provide Grade 3500HP for mainline pavement, shoulder, miscellaneous pavement (including ramps), concrete pavement overlay applications, and bridge substructure applications; Grade 4500HP for bridge deck applications; and either concrete Grade 3500HP or 4500HP for bridge approach slab applications. The Engineer may approve Grade 3500HP or 4500HP for other applications.

Unless otherwise specified in the contract, concrete mixtures with optimized aggregate gradation may be used instead of standard concrete mixtures, as approved by the Engineer.

D. **Air Content.** Air-entrained concrete is required unless otherwise specified.

The percentage of air in fresh concrete must meet the requirements of Table 1004-1. The Engineer will allow non-air-entrained concrete for use in steel piles that are not subject to freezing.

Use ASTM C231/C231M or ASTM C173/C173M to determine the air content of normal weight concrete. Use ASTM C173/C173M to determine the air content of lightweight concrete and concrete containing highly porous aggregates.

E. **Consistency.** Determine consistency using the slump test in ASTM C143/C143M. Ensure that slump does not exceed the specifications in Table 1004-1.

F. **Concrete Admixtures.** Unless otherwise specified in the contract, concrete admixtures must be selected from the Qualified Products List. The different types of admixtures are listed in subsection 903.02.

For night casting, a water-reducing admixture may be used instead of a water-reducing retarding admixture as long as the concrete can be placed

and finished in the sequence specified on the plans prior to initial set, the concrete is not subjected to residual vibration, and the concrete is not within the areas influenced by dead load deflections as a result of adjacent concrete placement operations. When the maximum air temperature is not forecasted to exceed 60°F for the day, the Contractor may use a water-reducing admixture or a water-reducing retarding admixture.

Ensure that concrete in concrete diaphragms contains a water-reducing admixture or a water-reducing retarding admixture.

Set accelerating admixtures are prohibited unless otherwise specified in the contract.

De-foaming (air detraining) admixtures are prohibited.

G. **Concrete Temperature.** Use ASTM C1064/C1064M to determine concrete temperature.

1004.04. Measurement and Payment

The cost of PCC is included in unit prices for related pay items.

The Engineer's QA test results will be used to determine the pay factor and price adjustments. The Contractor's QC will not be used for pay factor and price adjustments.

Pay factor and price adjustments will be applied according to the contract.

Table 1004-1:
Concrete Mixtures

		Concrete Grade								
		3000	**3500**	**3500HP[a],[b]**	**4000**	**4000HP[a],[b]**	**4500**	**4500HP[a],[b]**	**M**	**X**
Compressive strength (psi)	7 day	2200	2600	2600	3000	3000	3200	3200	Commercial-grade concrete containing 517 lb/cyd. Portland cement may be replaced with an SCM.	Unless otherwise specified, Grade X concrete contains 282 lb/cyd of cement.
	28 day	3000	3500	3500	4000	4000	4500	4500		
	70%	2100	2450	2450	2800	2800	3150	3150		
Flexural strength (psi)	7 day	500	550	550	600	600	625	625		
	28 day	600	650	650	700	700	750	750		
	70%	420	455	455	490	490	525	525		
Slump (inch)		[c]–[f]	[c]–[k]	[c]–[k]	[l]–[n]	[l]–[n]	[d]–[f]	[e]–[f]		
Cementitious material content (lb/cyd)		489–517	517–611[o]	470–564[o]	517–611	517–611	517–658	517–658		
Class of coarse aggregate		[p]–[r]								
Maximum w/cm ratio		0.45								
Air content range		5.5 – 8.5%								
Section reference		402, 403, 602, 803, 804, 806, 808, 810, 813, 814, 819	401, 602, 603, 705, 706, 712, 713, 718, 801, 802, 803, 810, 819	401, 602, 603, 706, 712, 713, 718, 801, 802, 803, 810, 819	705, 922	705, 922	706, 711, 712	706, 711, 712	N/A	N/A

HP = high performance

(a) HP mixtures require optimized gradation meeting subsection 1004.03.C.

(b) HP mixtures require 25 to 40% replacement of portland cement with an SCM.

(c) 0- to 3-inch slump for mixtures for pavements.

(d) 0- to 3-inch slump without admixtures or with Type A or D admixture.

(e) 0- to 6-inch slump after the addition of Type MR admixture.

(f) 0- to 7-inch slump after the addition of Type F or G admixture.

(g) 3- to 7-inch slump for tremie applications without admixture or with Type A or D admixture.

(h) 3- to 7-inch slump for tremie applications after the addition of Type MR admixture.

(i) 3- to 8-inch slump for tremie applications after the addition of Type F or G admixture.

(j) 6- to 8-inch slump for dry placed drilled shafts.

(k) 7- to 9-inch slump for wet placed drilled shafts.

(l) 3- to 5-inch slump without admixtures or with Type A or D admixture.

(m) 3- to 6-inch slump after the addition of Type MR admixture.

(n) 3- to 7-inch slump after the addition of Type F or G admixture.

(o) For concrete pavement repair mixtures, use 658 lb/cyd of cement when the weather is forecast to be above 50°F or 752 lb/cyd when the weather is forecast to be 50°F or below.

(p) Use aggregates only from geologically natural sources for pavement, shoulder, miscellaneous pavement (including ramps), concrete pavement overlay, bridge approach slab, structural concrete, drilled shaft, bridge railing, and bridge sidewalk applications.

(q) Unless otherwise required, use Coarse Aggregate 6AA or 17A for exposed structural concrete in bridges, retaining walls, and pump stations.

(r) The flexural and compressive strengths are not part of the specifications but are listed for informational purposes only and are the minimum strengths anticipated for the mix proportions specified for the various grades of concrete when cured under standard conditions.

Section 1005. Mortar and Grout Mixtures

1005.01. Description

This work consists of producing and furnishing mortars and grouts.

1005.02. Materials

Provide materials in accordance with the following:

Portland Cement Type I, Type IA 901
Masonry Cement Type N, Type S, Type M 901
Hydrated Lime Type S, Type SA 901
Fine Aggregate 2NS, 2MS 902
Air-Entraining Admixture 903
Water 911

A. **Standard Mortars and Grouts.** Proportion cement and fine aggregates as specified in Table 1005-1 and Table 1005-2 by weight for batches of at least 1 cubic yard and by weight or volume for smaller batches. Add water to obtain a mortar or grout of the required consistency.

B. **Non-shrinking Mortar and Grout, Type H-1 (Non-metallic).** Provide Type H-1 non-shrinking mortar and grout, selected from the Qualified Products List, for filling post-tensioning stress pockets in fascia beams of prestressed box beams, under leveling plates supporting structures, for grouting dowels, and under temporary supports.

C. **Expansive Grout, Type E-1.** Provide Type E-1 expansive grout for filling the void around post-tensioned tendons in precast concrete box beams. Proportion the grout as follows:

1. Type I portland cement, 94 pounds;
2. Water no greater than 5 gallons; and
3. Expansive admixture, as recommended by the manufacturer.

Do not use sand in the grout mixture. Do not use grout containing aluminum or other components that produce hydrogen, carbon dioxide, or oxygen gas.

Ensure that grout attains a 28-day minimum compressive strength of 3,000 psi in accordance with ASTM C942, except proportion the grout as specified in this subsection.

Do not use expansive admixtures, plasticizing, or water-reducing agents that contain chloride ions in excess of 0.50% by weight, fluorides, sulfides, nitrates, thixotropic additives, or chemicals that may contribute to stress corrosion in steel.

Provide admixtures in liquid or solid form. Use a gas-evolving material, well dispersed throughout the admixture. Provide grout with an unrestrained expansion from 5 to 10%, in accordance with ASTM C940/C490M, except proportion the grout as specified in this subsection and determine expansion at 3 hours.

1005.03. Construction

The contractor may remix mortars and grouts.

Do not retemper mortars and grouts or use grout and mortar after it begins to set.

Do not place mortar and grout on materials that are below 40°F. Provide protection to maintain a temperature of 45°F or higher during the curing period.

1005.04. Measurement and Payment

The cost of producing and furnishing mortar and grout is included in the unit prices for other relevant pay items.

Table 1005-1:
Proportioning Standard Mortars and Grouts by Dry Weight

		Materials				Mix Proportions by Dry Weight (lb/cyd)				
Mortar or Grout Type	**General Use**	**Portland Cement**	**Masonry Cement**	**Hydrated Lime**	**Fine Aggregate**	**Portland Cement**	**Masonry Cement**	**Hydrated Lime**	**Fine Aggregate**	**Net Water**
R-1 (grout)	Bond or primer coat	Type I, IA	—	—	2NS	1175	—	—	964	705
R-2 (mortar)[(a)]	Patching spalls; filling space between box beams	—	Type M	—	2MS	—	930	—	2137	415
		Type I	Type N	—	2MS	468	349	—	1991	415
		Type I, IA	—	Type S, SA	2MS	828	—	75	2016	415
		Type I, IA	—	—	2MS,2NS	930	—	—	1966	415
R-3 (mortar)[(a)]	Setting precast concrete barriers; filler between slope protection blocks and riprap	Type I, IA	—	—	2NS	765	—	—	2266	353

(a) Provide an entrained air content of 14% ±4% for mortars by using masonry cement, Type IA portland cement, Type SA lime, or an air-entraining admixture. Do not combine masonry cement and Type IA portland cement or Type IA portland cement and Type SA lime unless tests indicate that the air content is within acceptable limits.

Table 1005-2:
Proportioning Standard Mortars and Grouts by Bulk Volume Parts

		Materials				Mix Proportions by Bulk Volume Parts			
Mortar or Grout Type	**General Use**	**Portland Cement**	**Masonry Cement**	**Hydrated Lime**	**Fine Aggregate**	**Portland Cement**	**Masonry Cement**	**Hydrated Lime**	**Fine Aggregate**
R-1 (grout)	Bond or primer coat	Type I, IA	—	—	2NS	1	—	—	1
R-2 (mortar)[a]	Patching spalls; filling space between box beams	—	Type M	—	2MS	—	1	—	2½
		Type I	Type N	—	2MS	[b]	[b]	—	[b]
		Type I, IA	—	Type S, SA	2MS	[b]	—	[b]	[b]
		Type I, IA	—	—	2MS, 2NS	1	—	—	2½
R-3 (mortar)[a]	Setting precast concrete barriers; filler between slope protection blocks and riprap	Type I, IA	—	—	2NS	1	—	—	3½

(a) Provide an entrained air content of 14% ±4% for mortars by using masonry cement, Type IA portland cement, Type SA lime, or an air-entraining admixture. Do not combine masonry cement and Type IA portland cement, or Type IA portland cement and Type SA lime, unless tests indicate that the air content is within acceptable limits.

(b) Do not proportion by volume if blending cementitious materials (portland cement, masonry cement, or lime).