HANGAR 12 SERVICE CENTER WAREHOUSE ADDITION DASSAULT FALCON JET

POLK STANLEY WILCOX

LITTLE ROCK, ARKANSAS

PROJECT MANUAL **PSW PROJECT: 699H**

NO SILICONE SEALANT ALLOWED ON PROJECT PER INTERNATIONAL FIRE CODE SECT. 2404.3.2.1

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DASSAULT FALCON JET
LITTLE ROCK, ARKANSAS
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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 supplementary general requirements for the following:

1. Codes and Standards
2. Conflicting Requirements
3. Specifications and Drawing Conventions
4. Work Restrictions
5. Fees, Permits, and Inspection
6. Submittals
7. Products
8. Warranties
9. Delegated Design
10. Coordination Drawings
11. Operation and Maintenance Manuals
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13. Owner Training

1.03 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Engineer. 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": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

1. "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.

I. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

J. Basis-of-Design Product: A product in which a specific manufacturer's product is named on the drawings or is accompanied by the words "basis-of-design product" in the specifications, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

K. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

L. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

M. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

N. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

O. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

1.04 SYSTEM: AN ORGANIZED COLLECTION OF PARTS, EQUIPMENT, OR SUBSYSTEMS UNITED BY REGULAR INTERACTION.

A. Subsystem: A portion of a system with characteristics similar to a system.

B. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

C. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.05 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 in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ABMA	American Bearing Manufacturers Association	(202) 367-1155
	www.abma-dc.org	
AGA	American Gas Association	(202) 824-7000
	www.aga.org	
AIA	American Institute of Architects (The)	(800) 242-3837
	www.aia.org	(202) 626-7300
ANSI	American National Standards Institute	(202) 293-8020
	www.ansi.org	
ASCE	American Society of Civil Engineers	(800) 548-2723
	www.asce.org	(703) 295-6300

ASME	ASME International	(800) 843-2763
	(American Society of Mechanical Engineers International)	(973) 882-1170
	www.asme.org	
ASTM	ASTM International	(610) 832-9500
	(American Society for Testing and Materials International)	
	www.astm.org	
AWS	American Welding Society	(800) 443-9353
	www.aws.org	(305) 443-9353
CGA	Compressed Gas Association	(703) 788-2700
	www.cganet.com	
CSI	Construction Specifications Institute (The)	(800) 689-2900
	www.csinet.org	(703) 684-0300
EJMA	Expansion Joint Manufacturers Association, Inc.	(914) 332-0040
	www.ejma.org	
ISO	International Organization for Standardization	41 22 749 01 11
	www.iso.ch	
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.	(703) 281-6613
	www.mss-hq.com	

NEMA	National Electrical Manufacturers Association	(703) 841-3200
	www.nema.org	
NFPA	NFPA	(800) 344-3555
	(National Fire Protection Association)	(617) 770-3000
	www.nfpa.org	
STI	Steel Tank Institute	(847) 438-8265
	www.steeltank.com	
UL	Underwriters Laboratories Inc.	(877) 854-3577
	www.ul.com	(847) 272-8800

B. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ICC	International Code Council	(888) 422-7233
	www.iccsafe.org	

C. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA)	(800) 872-2253

CFR	Code of Federal Regulations	(866) 512-1800
	Available from Government Printing Office	(202) 512-1800
	www.gpoaccess.gov/cfr/index.html	
UFAS	Uniform Federal Accessibility Standards	(800) 872-2253
	Available from Access Board	(202) 272-0080
	www.access-board.gov	

1.06 CODES AND STANDARDS

A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.

B. Applicable codes and standards shall include all state laws, local ordinances, utility company regulations, and the applicable requirements of the following adopted codes and standards.

1. Building Codes for Arkansas
    a) International Building Code 2012
    b) Arkansas Fire Prevention Code 2021
    c) National Electrical Code 2020
    d) Arkansas Fuel Gas Code 2018
    e) Arkansas Energy Code 2014 (based on ANSI/ASHRAE/IESNA Standard 90.1-2007)
    f) Arkansas State Plumbing Code 2018
    g) International Mechanical Code 2021
    h) Accessibility Code ICC/ANSI A117.1 2003

1.07 CONFLICTING REQUIREMENTS

A. Conflicting requirements: If compliance with standards, codes, regulations, and specifications establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting

requirements that are different, but apparently equal, to Engineer for a decision 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 Engineer for a decision before proceeding.

1.08 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. 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. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.09 FEES, PERMITS, AND INSPECTIONS

A. All required fees, permits and inspections of all kind shall be obtained and paid for by the Contractor under the section of the specifications for which they are required.

B. Certificate of Final Inspection: Under each applicable section of the specifications, the Contractor shall, upon completion of the work under that section, furnish a certificate of final inspection to the Engineer from the inspection department having jurisdiction.

1.10 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit a schedule 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 Engineer 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. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    a) Submit revised submittal schedule to reflect changes in current status and timing for submittals.
3. Format: Arrange the following information in a tabular format:
    a) Specification Section number and title.
    b) Submittal category: Action; informational.
    c) Name of subcontractor.
    d) Description of the Work covered.
    e) Scheduled date for Engineer's final release or approval.

1.11 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit submittals to Architect.

2. Engineer will return annotated file.

B. Digital Data Files:

1. Electronic digital data files of the Project drawings may be provided by Architect for Contractor's use in preparing submittals.
2. Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer’s Release Form. A signed release form and any payment required must be returned to the Engineer prior to the transmission of an electronic digital data files.

C. 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 different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    a) Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer'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 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer 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 14 days for review of each resubmittal.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file 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.
   a) File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
4. Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
   a) Project name.
   b) Date.
   c) Name and address of Architect.
   d) Name and address of Engineer.
   e) Name of Contractor.
   f) Name of firm or entity that prepared submittal.
   g) Names of subcontractor, manufacturer, and supplier.
   h) Category and type of submittal.
   i) Submittal purpose and description.
   j) Specification Section number and title.
   k) Specification paragraph number or drawing designation and generic name for each of multiple items.
   l) Drawing number and detail references, as appropriate.
   m) Location(s) where product is to be installed, as appropriate.
   n) Related physical samples submitted directly.
   o) Indication of full or partial submittal.
   p) Transmittal number.
   q) Submittal and transmittal distribution record.
   r) Other necessary identification.
   s) Remarks.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a) Project name.
   b) Number and title of appropriate Specification Section.

c) Manufacturer name.
d) Product name.

F. Options: Identify options requiring selection by Engineer.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. 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 Engineer's action stamp.

I. 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.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

K. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Engineer’s Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product

request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 14 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a) Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

1.12 CLOSEOUT SUBMITTALS

A. Closeout submittals shall include, but not limited to, the following:

1. Operation and Maintenance Materials
2. Record Drawings
3. Demonstration and Training Materials
4. Final Approved Submittals

1.13 MAINTENANCE MATERIAL SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.
   a) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
   b) Enable inserted reviewer comments on draft submittals.
2. In addition to the electronic submit provide two paper copies of the corrected final submittal as part of the “Closeout Documents”. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer will return two copies. The two paper copies will be provided to the Owner as part of the “Closeout Documents”

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

1.14 QUALITY ASSURANCE

A. Products:

1. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.15 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

B. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage.

4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.16 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submit warranties in accordance with “Closeout Procedures.”

1.17 FIELD CONDITIONS

A. The Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

1.18 WARRANTY

A. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the plumbing, air conditioning, ventilating, heating and control systems under guarantees outlined above for a period of 1 full year after acceptance by the Engineer and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for 1 full year after final acceptance by the Engineer.

PART 2 - PRODUCTS

2.01 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals to Architect.
    a) Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

B. 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 not suitable 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.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale and sufficiently large to show all pertinent features of the item, method of connections, and notations clearly legible. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.

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.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100.

F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000.

G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700.

H. Maintenance Data: Comply with requirements specified in Section 01 7823.

I. 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 Engineers and owners, and other information specified.

J. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

K. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

L. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

M. Product Certificates: Submit written statements on manufacturer's letterhead certi fying that product complies with requirements in the Contract Documents.

N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

O. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

P. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports

on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

Q. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

R. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

S. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

T. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

2.02 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Were two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
4. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
5. Where products are accompanied by the term "as selected," Engineer will make selection.
6. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
7. Products containing asbestos shall not be used.
8. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
    a) Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
    b) Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:
    a) Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
    b) Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer" or similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.03 COMPARABLE PRODUCTS

A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections,

2.04 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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. Include the following information, as applicable:
   a) Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
   b) Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
   c) Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   d) Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
   e) Show location and size of access doors required for access to concealed dampers, valves, and other controls.
   f) Indicate required installation sequences.
   g) Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Mechanical and Plumbing Work: Show the following:
    a) Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b) Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c) Fire-rated enclosures around ductwork.
6. Electrical Work: Show the following:
    a) Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b) Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c) Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d) Location of pull boxes and junction boxes, dimensioned from column center lines.
7. Fire-Protection System: Show the following:
    a) Locations of standpipes, main piping, branch lines, pipe drops, and sprinkler heads.
8. Review: Engineer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make changes as directed and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: DXF operating in Microsoft Windows operating system.

2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and supply Portable Data File (PDF) format.
3. BIM File Incorporation: Provide coordination drawing files into Building Information Model established for Project.
    a) Provide three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Engineer.

2.05 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. 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.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

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."

2.06 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: 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. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

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. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
7. 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. 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: Enable bookmarking of 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.

2.07 OPERATION MANUALS

A. 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.

B. 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.

C. 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.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.08 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product 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.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.09 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. 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 warranty and bond information, as described below.

B. 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.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
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.

D. 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.

E. 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.

F. 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.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.10 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 archive 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 below first floor.
   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 Change Directive.
   k) Details not on the original Contract Drawings.
   l) Field records for variable and concealed conditions.
   m) 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 sets 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 Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file.

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 Engineer for resolution.
4. Engineer will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
    a) See Section 01 3300 for requirements related to use of Engineer's digital data files.
    b) Engineer 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 and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file.
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 Engineer.
    e) Name of Contractor.

PART 3 - EXECUTION

3.01 CONTRACTOR'S SUBMITTAL REVIEW

A. Action 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 Engineer.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.02 ENGINEER'S SUBMITTAL ACTION

A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to the 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 Engineer.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

3.03 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Disposal: Remove waste materials from Owner's property and legally dispose of them

3.04 OPERATION AND MAINTENANCE MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

    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.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.

    1. 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.

E. 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.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in "Project Record Documents."

F. Comply with "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

3.05 RECORD DRAWING RECORDING AND MAINTENANCE

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.

3.06 COORDINATION OF WORK

A. The Contractor shall compare the fire suppression Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the fire suppression work. The fire suppressions work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.

B. Anchor bolts, sleeves, inserts and supports that may be required for the fire suppression work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting

from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.

C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.

D. Locations of pipes and equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe prior to fabrication.

1. Right-of-Way: Lines which pitch shall have the right of way over those which do not pitch. For example: plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
2. Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all drains, etc., as required to effect these offsets, transitions and changes in direction.
3. Installation and Arrangement: The Contractor shall install all fire suppression work to permit removal (without damage to other parts) of belt guards, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.
4. Access: The Contractor shall provide all necessary access panels in walls, ceilings, equipment, ducts, etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves and dampers. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.

E. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in piping, supports, etc. The Contractor shall provide any additional valves, fittings, and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

F. Connections: All piping connecting to equipment shall be installed without strain at the piping connection

G. Inaccessible Equipment

1. Where the Engineer or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

H. Electrical Coordination

1. Power: All power and motor wiring shall be performed under Division 26 unless otherwise noted for specific items. Control and interlock wiring shall be done by the Contractor of this Division.
2. Starters and Drives: All motor starters and drives unless included in other sections of the specifications shall be by Division 26. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.

3. Disconnects: All equipment furnished under this Division required to have a means of disconnect shall be supplied with a disconnect or a disconnect shall be furnished and installed by Division 26. The Contractor shall coordinate between this Division 21 and Division 26 to ensure that all disconnects required for the Project are furnished and installed.
4. The Contractor of this Division shall furnish and install any low voltage relays, pressure switches, thermostats and similar items required for the proper operation of the HVAC equipment.

I. Dedicated Electrical Space: The space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone. The area above the dedicated space shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks or breaks in foreign systems. Every effort shall be made to eliminate foreign systems above equipment to the structural ceiling. If this is not possible, the Contractor shall encase any pipe in a second pipe with a minimum number of joints. Provide 18 gauge (minimum) galvanized, 4 inch (minimum) deep drain pans under piping and ductwork located or passing over electrical equipment. Pipe 1” drain from pan to nearest floor drain. Drain pan shall be adequately supported and constructed to hold 4 inches of water without collapse.

J. Lubrication: The Contractor shall be held responsible for all damage to bearings while the equipment is being operated up to the date of acceptance of the equipment. The Contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment

shall be provided with covers as required for proper protection during construction. Pump shafts, motor shafts, etc. shall be coated to prevent deterioration in moist or wet atmospheres.

3.07 PAINTING

A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications. Contractor shall paint equipment, piping, etc., in accordance with Division 9. Equipment specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.

B. Apply paint to exposed piping according to the following, unless otherwise indicated:

1. Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
2. Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include 2 finish coats over galvanized metal primer.
3. Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
4. Do not paint piping specialties with factory-applied finish.
5. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
6. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

END OF SECTION 21 0000

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Above ground piping.

B. Escutcheons.

C. Mechanical couplings.

D. Pipe hangers and supports.

1.02 RELATED REQUIREMENTS

A. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Piping identification.

B. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.03 REFERENCE STANDARDS

A. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.

C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2016.

E. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.

F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.

G. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

I. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.

J. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

K. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.

L. AWWA C606 - Grooved and Shouldered Joints; 2015.

M. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL (DIR) - Online Certifications Directory; Current Edition.

O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.

C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

D. Manufacturer's Qualification Statement.

E. Installer's Qualification Statement.

F. Project Record Documents: Record actual locations of components and tag numbering.

G. Operation and Maintenance Data: Include installation instructions and spare parts lists.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section.

1. Minimum three years experience.
2. Approved by manufacturer.

C. Comply with FM (AG) and UL (DIR) requirements.

D. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

E. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

A. Sprinkler Systems: Comply with NFPA 13.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 Schedule 10, ASTM A53 Schedule 40, ASTM A135/A135M Schedule 10, or ASTM A795 Schedule 40, black.

1. Steel Fittings: ASME B16.5 steel flanges and fittings.
2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
5. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.03 ESCUTCHEONS

A. Material:

1. Metals and Finish: Comply with ASME A112.18.1.

B. Construction:

1. One-piece for mounting on chrome-plated tubing, pipe, or _____ and one-piece, split-pattern, or _____ type elsewhere.
2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.04 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.

B. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

1. Rings used as support shall be Heavy Duty and capable of supporting the total load of the pipe being supported. Tolco 200H or approved equal.

C. Wall support: Welded knee-brace and U-Bolt or strut and clamp.

D. Vertical Support: Steel riser clamp.

E. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

F. Seismic Hangers and Couplings (Where required):

1. Provide coupling with a factory set disengagement rating of 140 percent to 160 percent of the static weight.
2. Provide resettable and reusable, break away couplings.
3. Provide tether cables to avoid excessive seismic joint movement.
4. Coupling to be manufactured from non-corrosive materials.

2.05 MECHANICAL COUPLINGS

A. Rigid Mechanical Couplings for Grooved Joints:

1. Dimensions and Testing: Comply with AWWA C606.
2. Minimum Working Pressure: 300 psig.
3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
4. Housing Coating: Factory applied orange enamel or _____.
5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

C. Install piping to conserve building space, to not interfere with use of space and other work.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Pipe Hangers and Supports:

1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
2. Place hangers within 12 inches of each horizontal elbow.
3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

H. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

I. Structural Considerations:

1. Do not penetrate building structural members unless indicated.

J. Provide sleeves when penetrating footings, floors, walls, partitions, and _____. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

K. Escutcheons:

1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
3. Attach plates at the underside only of suspended ceilings.
4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

L. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

M. Die-cut threaded joints with full-cut, standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 21 0500

SECTION 21 0523

GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.

1.02 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.

B. FM (AG) - FM Approval Guide; Current Edition.

C. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2025.

E. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Obtain valves for each valve type from single manufacturer.
2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

B. Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX.

D. Installer, Maintenance Contractor, and _____ Qualifications:

1. Company specializing in performing the work of this section with minimum five years documented experience.
2. Trained and approved by manufacturer to design, install, test and maintain the equipment specified herein.
3. Complies with manufacturer's certification requirements.
4. Complies with manufacturer's insurance requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.
   a) Provide temporary inlet and outlet caps.
   b) Maintain caps in place until installation.
2. Store valves in shipping containers and maintain in place until installation.

a) Store valves indoors and maintain at higher than ambient dew point temperature.
b) If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.

C. Use the following precautions for handling:

1. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:

B. FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:

1. Automated Sprinkler Systems:
   a) Indicator posts.

C. Comply with NFPA 13, NFPA 13R, and ____ for valves.

D. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Confirm valve interior to be free of foreign matter and corrosion.

B. Remove packing materials.

C. Examine guides and seats by operating valves from the fully open position to the fully closed position.

D. Examine valve threads and mating pipe for form and cleanliness.

3.02 INSTALLATION

A. Comply with specific valve installation requirements and application in the following Sections:

B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.

   1. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in water supply connections and backflow preventer at potable water supply connections.

D. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.

E. Valves in horizontal piping installed with stem at or above the pipe center.

F. Position valves to allow full stem movement.

G. Install valve tags. Comply with Section 21 0553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

END OF SECTION 21 0523

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Seismic control requirements.

1. Includes requirements for seismic qualification of equipment not specified in this section.

C. Vibration isolators.

D. External seismic snubber assemblies.

E. Seismic restraint systems

1.02 DEFINITIONS

A. Fire Suppression Component: Where referenced in this section in regards to seismic controls, applies to any portion of the fire suppression system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.

C. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.

D. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.

E. FM 1950 - Examination Standard for Seismic Sway Braces for Pipe, Tubing and Conduit; 2023.

F. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).

G. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 203A - Standard for Sway Brace Devices for Sprinkler System Piping; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Seismic Controls:
    a) Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
    b) Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.05 SUBMITTALS

A. See Division 01 for additional requirements.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
2. Seismic Controls: Include seismic load capacities.

D. Shop Drawings - Seismic Controls:

1. Include dimensioned plan views and sections indicating proposed fire suppression component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
2. Identify mounting conditions required for equipment seismic qualification.
3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
4. Indicate proposed arrangement of distributed system trapeze support groupings.
5. Indicate proposed locations for distributed system flexible fittings and/or connections.
6. Indicate locations of seismic separations where applicable.
7. Include point load drawings indicating design loads transmitted to structure at each attachment location.

E. Seismic Design Data:

1. Compile information on project-specific characteristics of actual installed fire suppression components necessary for determining seismic design forces required to design appropriate seismic controls.
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

F. Certification for seismically qualified equipment; identify basis for certification.

G. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

I. Evidence of qualifications for seismic controls designer.

J. Evidence of qualifications for manufacturer.

K. Manufacturer’s detailed field testing and inspection procedures.

L. Field quality control test reports.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.

1. Designer may be employed by the manufacturer of the seismic restraint products.

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing fire suppression equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:

1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.

D. Piping Isolation:

1. Use flexible piping connections to vibration-isolated equipment.

2.02 SEISMIC CONTROL REQUIREMENTS

A. Design and provide fire suppression component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor fire suppression components.

B. Seismic Design Criteria: Obtain from project Structural Engineer of Record or as indicated on the drawings.

C. Component Importance Factor (Ip): Fire suppression components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.

D. Seismic Qualification of Equipment:

1. Provide special certification for fire suppression equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.

2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

E. Premanufactured Modular Fire Suppression Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.

F. Seismic Restraints:

1. Provide seismic restraints for fire suppression components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
2. Seismic Restraint Exemptions, All Seismic Design Categories:
    a) Fire Suppression Piping Exemptions, All Seismic Design Categories:
        1) Lateral sway bracing for piping individually supported within 6 inches of the structure measured between the top of pipe and the point of attachment to the structure, where all conditions for exception specified in NFPA 13 are met.
        2) Lateral sway bracing for branch lines smaller than 2-1/2 inches in diameter, where branch line restraint is provided in accordance with NFPA 13.
3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
    a) ASHRAE (HVACA).
    b) FEMA 412.
    c) FEMA 413.
    d) FEMA 414.
    e) FEMA E-74.
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Type Vibration Isolators:

a) Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.

6. External Seismic Snubber Assemblies:
   a) Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
   b) Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
7. Seismic Restraint Systems:
   a) Arrange restraint elements to avoid obstruction of sprinklers in accordance with NFPA 13.
   b) Except where otherwise restricted, use of either cable or rigid restraints is permitted.
   c) Use only cable restraints to restrain vibration-isolated fire suppression components.
   d) Use only one restraint system type for a given fire suppression component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
   e) Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain fire suppression component in all lateral directions; consider bracket geometry in anchor load calculations.
   f) Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported fire suppression component weight.
   g) Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported fire suppression component weight.
   h) Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
   i) Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
   j) Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

G. Seismic Attachments:

1. Comply with support and attachment requirements of NFPA 13.

2. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
3. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
4. Do not use power-actuated fasteners.
5. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps, but not for sway bracing attachments as prohibited by NFPA 13.
6. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
7. Concrete Housekeeping Pads:
   a) Increase size of pad as required to comply with anchor requirements.
   b) Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

H. Seismic Interactions:

1. Include provisions to prevent seismic impact between fire suppression components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
3. Comply with minimum clearance requirements between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

I. Seismic Relative Displacement Provisions:

1. Use suitable fittings or flexible connections, in accordance with NFPA 13, to accommodate:
   a) Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
   b) Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
   c) Design displacements at seismic separations.
   d) Anticipated drifts between floors.
2. Provide clearance around fire suppression system piping extending through walls, floors, platforms, and foundations in accordance with NFPA 13.

2.03 VIBRATION ISOLATORS

A. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
   a) Color code or otherwise identify springs to indicate load capacity.
   b) Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
   c) Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
   d) Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
   e) Selected to provide designed deflection of not less than 75 percent of specified deflection.
   f) Selected to function without undue stress or overloading.
3. Seismic Snubbing Elements for Seismic Isolators:
   a) Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
   b) Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

B. Vibration Isolators for Seismic Applications:

1. Resilient Material Isolator Mounts, Seismic:
   a) Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
2. Restrained Spring Isolators, Seismic:
   a) Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
   b) Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
   c) Furnished with integral leveling device for positioning and securing supported equipment.
   d) Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:

a) Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.

4. Spring Isolator Hangers, Seismic:
   a) Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
   b) Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
   a) Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
   b) Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.04 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

B. Seismic Snubbing Elements:

1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.05 SEISMIC RESTRAINT SYSTEMS

A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

B. Where required by NFPA 13, provide products listed as complying with UL 203A or FM 1950.

C. Cable Restraints:

1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.

1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Seismic special inspections include, but are not limited to:

1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
3. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
4. Verification of required clearances between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.

D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

E. Vibration Isolation Systems:

1. Spring Isolators:
   a) Position equipment at operating height; provide temporary blocking as required.
   b) Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
   c) Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
2. Isolator Hangers:
   a) Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
   b) Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
3. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
4. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
5. Adjust isolators to be free of isolation short circuits during normal operation.
6. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

F. Seismic Controls:

1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
4. Equipment with Sheet Metal Housings:
   a) Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
   b) Attach additional steel as approved by manufacturer where required to transfer loads to structure.

c) Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.

5. Concrete Housekeeping Pads:
   a) Size in accordance with seismic design to meet anchor requirements.
   b) Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
   a) Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
   b) Install restraints within permissible angles in accordance with seismic design.
   c) Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
   d) Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
   e) Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

A. Inspect vibration isolation and/or seismic control components for damage and defects.

B. Vibration Isolation Systems:

1. Verify isolator static deflections.
2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

C. Seismic Controls:

1. Verify snubbing element air gaps.

D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 21 0548

SECTION 21 0553

IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Pipe markers.

C. Ceiling tacks.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Control Panels: Nameplates.

B. Instrumentation: Nameplates.

C. Major Control Components: Nameplates.

D. Piping: Tags.

E. Pumps: Nameplates.

F. Small-sized Equipment: Nameplates.

G. Valves: Nameplates and ceiling tacks where above lay-in ceilings.

2.02 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Thickness: 1/8 inch.
5. Plastic: Comply with ASTM D709.

B. Metal rectangular nameplates to be used on valves. Indicate "NORMALLY OPEN" or "NORMALLY CLOSED" in all valves.

2.03 PIPE MARKERS

A. Color: Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

E. Lettering to be "FIRE PROTECTION WATER" or submit other text as appropriate.

F. Color code as follows:

1. Fire Quenching Fluids: Red with white letters.

2.04 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:

1. Sprinkler Valves: _____.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install plastic pipe markers in accordance with manufacturer's instructions.

C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

D. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

E. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 21 0553

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water pipe.

B. Valves.

C. Fire department connections.

D. Private fire hydrants.

E. Bedding and cover materials.

F. Polyethylene jacketing (encasement).

G. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 21 1300 - Fire-Suppression Sprinkler Systems.

1.03 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

C. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.

D. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

F. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).

G. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

H. ASTM A674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe; 2022.

I. ASTM B63 - Standard Test Method for Resistivity of Metallically Conducting Resistance and Contact Materials; 2007 (Reapproved 2026).

J. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.

K. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2026a.

L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025, with Amendment (2026).

M. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings; 2022.

N. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.

O. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.

P. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.

Q. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).

R. AWWA C502 - Dry-Barrel Fire Hydrants; 2024.

S. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.

T. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.

U. AWWA M11 - Steel Pipe - A Guide for Design and Installation; 2017, with Addendum (2019).

V. FM (AG) - FM Approval Guide; Current Edition.

W. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

X. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Division 01 for additional requirements.

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.
2. Provide manufacturer's catalog information.
3. Indicate valve data and ratings.
4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Project Record Documents:

1. Record actual locations of piping mains, valves, connections, fire hydrants, free-standing fire department connections, underground manholes and vaults, valve boxes, thrust restraints, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

F. Maintenance Data: Include installation instructions, spare parts lists, and exploded assembly views.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Division 01 for additional requirements.

1.06 QUALITY ASSURANCE

A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

E. Provide grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

F. Date stamp castings used for coupling housings, fittings, and valve bodies for quality assurance and traceability.

G. Welder Qualifications:

1. Certify in accordance with ASME BPVC-IX.

2. Provide certificate of compliance from local Authority Having Jurisdiction, indicating approval of welders.

H. Valves: Bearing product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.08 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

1.09 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 WATER PIPE

A. Ductile Iron Pipe: Listed, AWWA C104/A21.4:

1. Fittings: Ductile iron, standard thickness.
2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket with rods.
3. Jackets: AWWA C105/A21.5 polyethylene jacket.

2.02 VALVES

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Detector Check with Water Meter:

C. Detector Check Valve, Flanged End:

1. 4 inch NPS up to and including 10 inch NPS:
    a) Construction:
        1) Body: Constructed of 300 series stainless steel or ASTM A536 ductile iron to AWWA C550, as applicable.
        2) Coating: Fusion bonded epoxy in accordance with AWWA C550.
        3) Spring and Linkage: Stainless steel.
        4) Removable Clapper Seat Ring: Bronze.
        5) Seat: ASTM B63 bronze.
        6) Maximum Working Pressure: 175 psi.

D. Double Check Detector Valve Assembly, Flanged End:

1. 2-1/2 NPS up to and including 10 NPS:
    a) Construction:
        1) Two independently operating, spring-loaded, check valves.
        2) Two OSY resilient seated gate valves.
        3) Bypass Assembly:
            (a) Bypass Line: Hydraulically sized to accurately measure low flow.
            (b) Double check including shut-off valves, and required cocks.
        4) Cam-Check:
            (a) Internally loaded, providing positive, drip-tight closure against reverse flow.
            (b) Stainless steel cam arm and spring, rubber-faced disc, and replaceable, thermoplastic seat.
        5) Valve Cover:
            (a) Provides access to all internal parts.
            (b) Held in place through the use of a single grooved style two-bolt coupling.

2.03 FIRE DEPARTMENT CONNECTIONS:

A. Free-Standing Inlet:

1. Construction:
    a) Type: Exposed, projected wall mount..
    b) Inlets: Two way, 2-1/2 inch female inlets, thread size compatible with fire department hardware.
    c) Rated Working Pressure: 175 psi.
    d) Double clapper-valves, rocker-lug caps and chain, and cast-in function-identifying lettering.
    e) Finish: Polished brass.
    f) Label: Sprinkler - Fire Department Connection.

2.04 PRIVATE FIRE HYDRANTS

A. Dry-Barrel:

1. Construction:
   a) Rated Working Pressure: 250 psi.
   b) Compression type, opening against system pressure and closing with system pressure.
   c) Traffic breakaway type.
2. Hydrant Cap and Stuffing Box: One piece design with water-tight cavity, sealed from contact with water.
3. Operating Nut: One-Piece, bronze construction with protective weather seal, shield, or _____.
4. Nozzles: Tamper resistant, 1/4 turn type with O-ring seals including retaining/locking screws, other suitable nozzle lock, or _____ to prevent inadvertent removal.
5. Main Valve: Provide reinforced, synthetic rubber, completely encapsulated with EPDM, or _____.
6. Seat: Provide O-rings to seal drain-way and barrel from water leakage into shoe.
7. Drains to momentarily flush outward when opened to remove debris and complete draining upon closing of the main valve.

2.05 POLYETHYLENE JACKETING (ENCASEMENT)

A. Comply with AWWA C105/A21.5, ASTM A674, or _____.

B. Jackets: Double layer, half lapped, 10 mil polyethylene tape.

C. Type: Provide tubular based on the application.

D. Color: Manufacturer's standard color.

2.06 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in Section 03 3000.

B. Tracer Wire:

1. Provide magnetic, detectable conductor with clear plastic covering and imprinted with "Water Service" in large letters.
2. Conductor to be of sufficient length to be continuous over each separate run of nonmetallic pipe.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.02 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

A. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide ____ sq feet thrust restraint bearing on subsoil.

C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION

A. General Requirements:

1. Location of Water Lines:
2. Sleeving:
    a) Sleeve water piping where piping is required to be installed within 3 feet of existing structures.
    b) Provide ductile iron, Schedule 40 steel, or _____ sleeves.
    c) Fill annular space between pipe and sleeves with mastic.
    d) Install water pipe and sleeve without damaging structures or causing settlement or movement of foundations or footings.
3. Pipe Laying and Jointing:
    a) Remove fins and burrs from pipe and fittings.
    b) Prior to placing in position, clean pipe, fittings, valves, and accessories, and maintain in clean condition.
    c) Provide proper facilities for lowering pipe sections into trenches.

d) Dropping or dumping of piping, fittings, valves, or any other water line material into trenches is not permitted.
e) Cut pipe in a neat, workmanlike manner accurately to length established at the site and work into place without forcing or springing.
f) Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material.
g) Wedging or blocking between bells and spigots will not be permitted.
h) Install bell-and-spigot pipe with the bell end pointing in the direction of laying.
i) Grade the pipeline in straight lines avoiding the formation of dips and low points.
j) Support piping at proper elevation and grade.
k) Secure firm, uniform support.
l) Wood support blocking will not be permitted.
m) Install pipe so that the full length of each pipe section and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings.
n) Provide proper provisions for expansion and contraction of pipelines.
o) Keep trenches free of water until joints have been properly made.
p) Close open ends of piping temporarily with wood blocks or bulkheads at the end of each workday.
q) Do not install pipe during unacceptable trench conditions or inclement weather.
r) Minimum Depth of Pipe Cover: Not less than 2-1/2 feet.

4. Tracer Wire:
   a) Install continuous length of tracer wire for the full length of each run of nonmetallic pipe.
   b) Attach wire to top of pipe securely to prevent displacement during installation.
5. Connections to Existing Water Lines:
   a) Ensure minimal interruption of service on the existing line.
   b) Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.
6. Penetrations:
   a) Provide ductile-iron, Schedule 40 steel, or _____ for pipes passing through walls of valve pits and structures.
   b) Fill annular space between sleeves and walls with rich cement mortar.
   c) Fill annular space between pipe and sleeves with mastic.

B. Special Requirements:

1. Ductile Iron Piping:

a) Unless otherwise specified, install pipe and fittings in accordance with paragraph "General Requirements".
b) Jointing:
c) Allowable Deflection:
    1) Maximum Allowable Deflection: As stated in AWWA C600.
    2) If the alignment requires deflection in excess of the above limitations, furnish special blends, a sufficient number of shorter pipe lengths, or _____ to provide angular deflections within the limit set forth.
d) Pipe Anchorage:
    1) Provide concrete thrust blocks (reaction backing), for pipe anchorage except where metal harness is indicated.
    2) Thrust blocks to comply with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks to be as indicated.
    3) Use concrete, ASTM C94/C94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2-1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.
    4) Provide metal harness in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as indicated in NFPA 13, except as otherwise indicated.
e) Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class A polyethylene film, in accordance with AWWA C105/A21.5.

C. Valves:

1. Set valves on solid bearing.
2. Center and plumb valve box over valve.
3. Set box cover flush with finished grade.

D. Fire Hydrants:

1. Install in accordance with NFPA 13, the Local Authority Having Jurisdiction, the local water utility, and _____.
2. Set fire hydrant plumb and brace at grades and locations in upright position and as indicated.
3. Provide thrust blocks on all hydrant tees.
    a) Provide thrust block behind hydrant shoe if hydrant lateral is not restrained.
    b) Avoid covering drain ports, bolts, or fittings when placing concrete thrust block.
4. Install each fire hydrant with separate gate valve in supply pipe.

5. Installation of hydrants requiring changes in bury depth due to unforeseen obstructions requires the approval of the Architect in writing prior to installation.
6. Coating Requirements:
    a) Provide a color chip code sample in accordance with applicable NFPA standards for the hydrant bonnet indicating available flow at 20 psi according to the following:
        1) Supply Water Line Flow Characteristics/Bonnet Color:
7. Remove and dispose of unsuitable materials and debris in accordance with local or state requirements.

END OF SECTION 21 1100

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire hose cabinets.

B. Valves.

1.02 RELATED REQUIREMENTS

A. Section 01 4100 - Regulatory Requirements.

B. Section 21 0500 - Common Work Results for Fire Suppression: Fire protection piping.

C. Section 21 0523 - General-Duty Valves for Water-Based Fire-Suppression Piping.

D. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.

E. Section 21 1300 - Fire-Suppression Sprinkler Systems.

1.03 REFERENCE STANDARDS

A. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2024.

B. NFPA 1963 - Standard for Fire Hose Connections; 2019.

C. UL (DIR) - Online Certifications Directory; Current Edition.

D. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's catalog sheet for equipment indicating rough-in size, finish, and accessories.

B. Shop Drawings: Indicate supports, components, accessories, and sizes.

C. Project Record Documents: Record actual locations of components.

D. Operation Data: Include appropriate manufacturer's data.

E. Certificates: Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Hoses: One.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 14. Maintain one copy on site.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum ___ years documented experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in shipping packaging until installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 VALVES

A. General Duty Valves: Refer to Section 21 0523.

B. Specialty Valves:

1. Hose Connection Valve:
   a) Angle type; brass finish; 2-1/2 NPS, thread to match fire department hardware, 300 psi working pressure, with threaded cap and chain of same material and finish.

C. Hose Connection Valve Cabinets:

1. Style: Recessed mounted. 1-3/4" trim.

2. Tub: 16 gage, 0.0598 inch thick steel, prepared for pipe and accessory rough-in.
3. Door: 12 gage, 0.1046 inch thick steel, flush, glazed with 1/4 inch (6.35 mm) thick wired glass full panel; hinged, positive latch device.
4. Finish: Aluminum, clear anodized..

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 14.

C. Connect standpipe system to water source ahead of domestic water connection.

D. Flush entire system of foreign matter.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection and testing (Field Acceptance Test) in accordance with Section 01 4000.

B. Test entire system in accordance with NFPA 14.

C. Test shall be witnessed by Fire Marshal.

END OF SECTION 21 1200

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 supplementary general requirements for the following :

1. Codes and Standards
2. Conflicting Requirements
3. Specifications and Drawing Conventions
4. Fees, Permits, and Inspection
5. Submittals
6. Closeout Submittals
7. Quality Assurance
8. Product Delivery, Storage, and Handling
9. Product Warranties
10. Product Selection Procedures
11. Delegated Design
12. Coordination Drawings
13. Emergency, Operation, and Maintenance Manuals
14. Construction Waste
15. General Coordination for Plumbing Work
16. Cutting and Patching
17. Painting

1.03 DEFINITIONS

A. "Action Submittals": Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Basis-of-Design Product": A product in which a specific manufacturer's product is named on the drawings or is accompanied by the words "basis-of-design product" in the specifications, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

D. "Construction Waste": Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

E. "Cutting": Removal of in-place construction necessary to permit installation or performance of other work.

F. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

G. "Disposal": Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

H. "File Transfer Protocol (FTP)": Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

I. "Furnish": To supply, deliver, unload, and inspect for damage.

J. "General": Basic Contract definitions are included in the Conditions of the Contract.

K. "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."

L. "Informational Submittals": Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

M. "Install": To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

N. "Patching": Fitting and repair work required to restore construction to original conditions after installation of other work.

O. "Portable Document Format (PDF)": An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

P. "Product": Material, machinery, components, equipment, fixtures,and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Product may be new, never before used, or re-used materials or equipment.

Q. "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.

R. "Provide": Furnish and install, complete and ready for the intended use.

S. "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.

T. "Salvage": Recovery of demolition and construction waste and subsequent sale or reuse in another facility.

U. "Salvage and Reuse": Recovery of demolition and construction waste and subsequent incorporation into the Work.

V. "System": An organized collection of parts, equipment, or subsystems united by regular interaction.

W. "Subsystem": A portion of a system with characteristics similar to a system.

1.04 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 in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AGA	American Gas Association	(202) 824-7000
	www.aga.org	
AIA	American Institute of Architects (The)	(800) 242-3837
	www.aia.org	(202) 626-7300
ANSI	American National Standards Institute	(202) 293-8020
	www.ansi.org	
ASCE	American Society of Civil Engineers	(800) 548-2723
	www.asce.org	(703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers	(800) 527-4723

	www.ashrae.org	(404) 636-8400
ASME	ASME International	(800) 843-2763
	(American Society of Mechanical Engineers International)	(973) 882-1170
	www.asme.org	
ASTM	ASTM International	(610) 832-9500
	(American Society for Testing and Materials International)	
	www.astm.org	
AWS	American Welding Society	(800) 443-9353
	www.aws.org	(305) 443-9353
CGA	Compressed Gas Association	(703) 788-2700
	www.cganet.com	
CIMA	Cellulose Insulation Manufacturers Association	(888) 881-2462
	www.cellulose.org	(937) 222-2462
CSI	Construction Specifications Institute (The)	(800) 689-2900
	www.csinet.org	(703) 684-0300
EJMA	Expansion Joint Manufacturers Association, Inc.	(914) 332-0040
	www.ejma.org	
HI	Hydronics Institute	(908) 464-8200
	www.gamanet.org	
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association	(908) 464-8200
	Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI)	
	www.ahrinet.org	
IGMA	Insulating Glass Manufacturers Alliance	(613) 233-1510
	www.igmaonline.org	

ISA	Instrumentation, Systems, and Automation Society, The	(919) 549-8411
	www.isa.org	
ISO	International Organization for Standardization	41 22 749 01 11
	www.iso.ch	
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.	(703) 281-6613
	www.mss-hq.com	
NEBB	National Environmental Balancing Bureau	(301) 977-3698
	www.nebb.org	
NEMA	National Electrical Manufacturers Association	(703) 841-3200
	www.nema.org	
NFPA	NFPA	(800) 344-3555
	(National Fire Protection Association)	(617) 770-3000
	www.nfpa.org	
STI	Steel Tank Institute	(847) 438-8265
	www.steeltank.com	
TEMA	Tubular Exchanger Manufacturers Association	(914) 332-0040
	www.tema.org	
UL	Underwriters Laboratories Inc.	(877) 854-3577
	www.ul.com	(847) 272-8800
USGBC	U.S. Green Building Council	(800) 795-1747
	www.usgbc.org	

B. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ICC	International Code Council	(888) 422-7233
	www.iccsafe.org	

C. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DOE	Department of Energy	(202) 586-9220
	www.energy.gov	
EPA	Environmental Protection Agency	(202) 272-0167
	www.epa.gov	
FCC	Federal Communications Commission	(888) 225-5322
	www.fcc.gov	
OSHA	Occupational Safety & Health Administration	(800) 321-6742
	www.osha.gov	(202) 693-1999
PHS	Office of Public Health and Science	(202) 690-7694
	http://www.hhs.gov/ophs/	
USP	U.S. Pharmacopeia	(800) 227-8772
	www.usp.org	
USPS	Postal Service	(202) 268-2000
	www.usps.com	

D. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA)	(800) 872-2253
CFR	Code of Federal Regulations	(866) 512-1800
	Available from Government Printing Office	(202) 512-1800
	www.gpoaccess.gov/cfr/index.html	

1.05 CODES AND STANDARDS

A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.

B. Applicable codes and standards shall include all state laws, local ordinances, utility company regulations, and the applicable requirements of the following adopted codes and standards.

1. Building Codes for Arkansas
    a) International Building Code 2006
    b) Arkansas Fire Prevention Code 2007
    c) National Electrical Code 2017
    d) Arkansas Fuel Gas Code 2018 (International Fuel Gas Code 2018)
    e) Arkansas Energy Code 2011 (based on ANSI/ASHRAE/IESNA Standard 90.1-2007)
    f) Arkansas State Plumbing Code 2018
    g) Arkansas Mechanical Code 2010
    h) Accessibility Code ICC/ANSI A117.1 2003

1.06 CONFLICTING REQUIREMENTS

A. Conflicting requirements: If compliance with standards, codes, regulations, and specifications establish different or conflicting requirements for minimum quantities or

quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision 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 Engineer for a decision before proceeding.

1.07 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. 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. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
4. The Plumbing Drawings show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to the requirements shown on all of the drawings. General and Structural Drawings shall take precedence over Plumbing Drawings. Because of the small scale of the Plumbing Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, offsets, valves and accessories as may be required to meet such conditions.

1.08 FEES, PERMITS, AND INSPECTIONS

A. All required fees, permits and inspections of all kind shall be obtained and paid for by the Contractor under the section of the specifications for which they are required.

B. Certificate of Final Inspection: Under each applicable section of the specifications, the Contractor shall, upon completion of the work under that section, furnish a certificate of final inspection to the Engineer from the inspection department having jurisdiction.

1.09 SUBMITTALS

A. Submittal Schedule

1. Submit a schedule 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 Engineer and additional time for handling and reviewing submittals required by those corrections.
   a) Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   b) Initial Submittal: 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.
   c) Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

1) Submit revised submittal schedule to reflect changes in current status and timing for submittals.

d) Format: Arrange the following information in a tabular format:

1) Scheduled date for first submittal.
2) Specification Section number and title.
3) Submittal category: Action; informational.
4) Name of subcontractor.
5) Description of the Work covered.
6) Scheduled date for Engineer's final release or approval.

B. Submittal Administrative Requirements

1. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   a) Submit submittals to Engineer through the Architect.
   b) Engineer, through Architect, will return annotated file.
2. Digital Data Files:
   a) Electronic digital data files of the Project drawings may be provided by Engineer for Contractor's use in preparing submittals.
   b) Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer’s Release Form. A signed release form and any payment required must be returned to the Engineer prior to the transmission of an electronic digital data files.
   c) Electronic digital data file formats may include AutoCAD drawings, Revit converted to AutoCAD drawings, or Revit model.
3. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   a) Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   b) Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
   c) Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   d) Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      1) Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
4. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer'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.

a) Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
b) Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
c) Resubmittal Review: Allow 14 days for review of each resubmittal.

5. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
   a) 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.
   b) Name file with submittal number or other unique identifier, including revision identifier.
      1) File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
   c) Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
   d) Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
      1) Project name.
      2) Name and address of Architect.
      3) Name and address of Engineer.
      4) Name of Contractor.
      5) Name of firm or entity that prepared submittal.
      6) Names of subcontractor, manufacturer, and supplier.
      7) Category and type of submittal.
      8) Submittal purpose and description.
      9) Specification Section number and title.
      10) Specification paragraph number or drawing designation and generic name for each of multiple items.
      11) Drawing number and detail references, as appropriate.
      12) Location(s) where product is to be installed, as appropriate.
      13) Related physical samples submitted directly.
      14) Indication of full or partial submittal.

15) Transmittal number.
16) Submittal and transmittal distribution record.
17) Other necessary identification.
18) Remarks.

e) Metadata: Include the following information as keywords in the electronic submittal file metadata:
1) Project name.
2) Number and title of appropriate Specification Section.
3) Manufacturer name.
4) Product name.

6. Options: Identify options requiring selection by Engineer.
7. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
8. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
a) Note date and content of previous submittal.
b) Note date and content of revision in label or title block and clearly indicate extent of revision.
c) Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
9. 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.
10. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.
11. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
a) Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
b) Engineer’s Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor through Architect of approval or rejection of proposed comparable product request within 14 days

of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

1) Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

1.10 CLOSEOUT SUBMITTALS

A. Closeout submittals shall include, but not limited to, the following:

1. Operation and Maintenance Materials
2. Final Approved Submittals

B. Operation and Maintenance Materials Submittals

1. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
   a) Engineer will comment on whether content of operations and maintenance submittals are acceptable.
   b) Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
2. Format: Submit operations 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 Engineer.
      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.
   b) In addition to the electronic submit provide two paper copies of the corrected final submittal as part of the “Closeout Documents”. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer, through Architect, will return two copies. The two paper copies will be provided to the Owner as part of the “Closeout Documents”
3. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 days before commencing demonstration and training. Engineer will return copy with comments.
   a) Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

C. 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 not suitable 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 showing factory-installed wiring.
   b) Printed performance curves.
   c) Operational range diagrams.
   d) Clearances required to other construction, if not indicated on accompanying Shop Drawings.

D. Shop Drawings: Prepare Project-specific information, drawn accurately to scale and sufficiently large to show all pertinent features of the item, method of connections, and notations clearly legible. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.

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.

E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."

F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."

G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."

H. Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."

I. 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 Engineers and owners, and other information specified.

J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

K. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

N. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

O. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

P. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

Q. Pre-construction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

R. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

S. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

1.11 QUALITY ASSURANCE

A. Products:

1. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
   a) Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
   b) If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.12 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project Site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.

3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage..
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.13 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submit warranties in accordance with “Closeout Procedures.”

1.14 FIELD CONDITIONS

A. The Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

1.15 WARRANTY

A. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the plumbing under guarantees outlined above for a period of 1 full year after acceptance by the Engineer and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for 1 full year after final acceptance by the Engineer.

PART 2 PRODUCTS

2.01 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 Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit 2 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.

2.02 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Were two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
4. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
5. Where products are accompanied by the term "as selected," Architect will make selection.
6. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
7. Products containing asbestos shall not be used.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
   a) Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
   b) Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:

a) Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
b) Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Selection Procedure: Where Specifications include the phrase "as selected by Architect" or similar phrase, select a product that complies with requirements.

Architect will select option from manufacturer's product line that includes both standard and premium items.

D. Comparable Products

1. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
a) Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
b) Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
c) Evidence that proposed product provides specified warranty.
d) List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.

e) Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections,

2.03 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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. Include the following information, as applicable:
   a) Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
   b) Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
   c) Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   d) Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
   e) Show location and size of access doors required for access to concealed valves and other controls.
   f) Indicate required installation sequences.
   g) Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, low voltage, and electrical work. Supplement plan drawings with section drawings where required to adequately represent the work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical, plumbing,fire protection, low voltage, and electrical equipment, and related work.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, low voltage, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Mechanical and Plumbing Work: Show the following:
   a) Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b) Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c) Fire-rated enclosures around ductwork.
6. Electrical Work: Show the following:
   a) Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
   b) Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
   c) Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
   d) Location of pull boxes and junction boxes, dimensioned from column center lines.
7. Fire-Protection System: Show the following:
   a) Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
8. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: DXF operating in Microsoft Windows operating system.
2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and supply Portable Data File (PDF) format.

2.04 EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. 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.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

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."

F. 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.

G. 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: Enable bookmarking of 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.

H. Operation Manual

1. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   a) System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
   b) Performance and design criteria if Contractor has delegated design responsibility.
   c) Operating standards.
   d) Operating procedures.
   e) Operating logs.
   f) Wiring diagrams.
   g) Control diagrams.
   h) Piped system diagrams.
   i) Precautions against improper use.
   j) License requirements including inspection and renewal dates.
2. Descriptions: Include the following:
   a) Product name and model number. Use designations for products indicated on Contract Documents.
   b) Manufacturer's name.
   c) Equipment identification with serial number of each component.
   d) Equipment function.
   e) Operating characteristics.
   f) Limiting conditions.
   g) Performance curves.
   h) Engineering data and tests.
   i) Complete nomenclature and number of replacement parts.
3. Operating Procedures: 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) Instructions on stopping.
f) Normal shutdown instructions.
g) Seasonal and weekend operating instructions.
h) Required sequences for electric or electronic systems.
i) Special operating instructions and procedures.

4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

I. Maintenance Manuals

1. Content: Organize manual into a separate section for each product, system, subsystem, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
2. Source Information: List each product, system, or subsystem 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.
3. Product Information: Include the following, as applicable:
   a) Product name and model number.
   b) Manufacturer's name.
   c) Color, pattern, and texture.
   d) Material and chemical composition.
   e) Reordering information for specially manufactured products.
   f) Standard maintenance instructions and bulletins.
   g) Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   h) Identification and nomenclature of parts and components.
   i) List of items recommended to be stocked as spare parts.
4. Maintenance Procedures: Include manufacturer's written recommendations and 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) Schedule for routine cleaning and maintenance.
   e) Repair instructions.
   f) Test and inspection instructions.
   g) Troubleshooting guide.
   h) Precautions against improper maintenance.

i) Disassembly; component removal, repair, and replacement; and reassembly instructions.
j) Aligning, adjusting, and checking instructions.
k) Demonstration and training video recording, if available.

5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
6. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   a) Include procedures to follow and required notifications for warranty claims.
7. 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.
   a) Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   b) Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
8. 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.
9. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
10. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
    a) Include procedures to follow and required notifications for warranty claims.

PART 3 EXECUTION

3.01 CONTRACTOR'S SUBMITTAL REVIEW

A. Action 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. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.02 ENGINEER'S SUBMITTAL ACTION

A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to the Architect to forward to the 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 Engineer.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

3.03 CONSTRUCTION WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Disposal: Remove waste materials from Owner's property and legally dispose of them

3.04 GENERAL COORDINATION FOR PLUMBING WORK

A. The Contractor shall compare the Plumbing Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the Plumbing Work. The Plumbing Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.

B. Anchor bolts, sleeves, inserts and supports that may be required for the Plumbing Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.

C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.

D. Locations of pipes, equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe and duct prior to fabrication.

1. Right-of-Way: Lines which pitch shall have the right of way over those which do not pitch. For example: plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
2. Offsets, transitions and changes in direction in pipes shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, air vents, sanitary vents, etc., as required to effect these offsets, transitions and changes in direction.
3. Installation and Arrangement: The Contractor shall install all Plumbing Work to permit removal (without damage to other parts) of coils, heat exchanger bundles, belt guards, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.
4. Access: The Contractor shall provide all necessary access panels in walls, ceilings, equipment, etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.

E. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in piping, supports, insulation, etc. The Contractor shall provide any additional valves, fittings, and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be

responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

F. Connections: All piping connecting to equipment shall be installed without strain at the piping connection

G. Inaccessible Equipment

1. Where the Engineer or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

H. Electrical Coordination

1. Power: All power and motor wiring shall be performed under Division 26 unless otherwise noted for specific items. Control and interlock wiring shall be done by the Contractor of this Division.
2. Starters and Drives: All motor starters and drives unless included in other sections of the specifications shall be by Division 26. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.
3. Disconnects: All equipment furnished under this Division required to have a means of disconnect shall be supplied with a disconnect or a disconnect shall be furnished and installed by Division 26. The Contractor shall coordinate between this Division and Division 26 to ensure that all disconnects required for the Project are furnished and installed.
4. The Contractor of this Division shall furnish and install any low voltage relays, pressure switches, and similar items required for the proper operation of the Plumbing equipment.

I. Dedicated Electrical Space: The space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation.

No piping, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone. The area above the dedicated space shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks or breaks in foreign systems. Every effort shall be made to eliminate foreign systems above equipment to the structural ceiling. If this is not possible, the Contractor shall encase any pipe in a second pipe with a minimum number of joints.

3.05 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Under each section of the specifications, the Contractor shall be responsible for all required cutting, etc., incident to his work under that section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any major structural element, beam or column.
2. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades because of fault, error or tardiness or because of any damage done by own workmanship.
3. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Proceed with patching after construction operations requiring cutting are complete.

D. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    a) Clean piping and similar features before applying paint or other finishing materials.
    b) Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    a) Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

E. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.06 PAINTING

A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications.

Contractor shall paint equipment, piping, etc., in accordance with Division 9.

Equipment specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.

B. Apply paint to exposed piping according to the following, unless otherwise indicated:

1. Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
2. Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include 2 finish coats over galvanized metal primer.
3. Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
4. Do not paint piping specialties with factory-applied finish.
5. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
6. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

END OF SECTION 22 0000

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.

B. Thermometers and thermometer wells.

C. Static pressure gauges.

1.02 RELATED REQUIREMENTS

A. Section 23 0923 - Direct-Digital Control System for HVAC.

1.03 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).

D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Division 01 for additional requirements.

1.05 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
3. Omega Engineering, Inc: www.omega.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel with brass bourdon tube.
2. Size: 4-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi.

2.02 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

2.03 STEM TYPE THERMOMETERS

A. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.

1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Accuracy: 2 percent, per ASTM E77.
4. Calibration: Degrees F.

2.04 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.05 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.06 STATIC PRESSURE GAUGES

A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.

C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

C. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 0943.

D. Coil and conceal excess capillary on remote element instruments.

E. Provide instruments with scale ranges selected according to service with largest appropriate scale.

F. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

G. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

H. Locate test plugs where indicated.

END OF SECTION 22 0519

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applications.

B. General requirements.

C. Ball valves.

D. Butterfly valves.

E. Check valves.

F. Plug valves.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 08 3100 - Access Doors and Panels.

C. Section 22 0553 - Identification for Plumbing Piping and Equipment.

D. Section 22 0719 - Plumbing Piping Insulation.

E. Section 22 1005 - Plumbing Piping.

1.03 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non-rising stem.

E. OS&Y: Outside screw and yoke.

F. PTFE: Polytetrafluoroethylene.

G. TFE: Tetrafluoroethylene.

1.04 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding; 2017.

B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).

C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.

D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.

E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.

F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

G. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.

H. ASME B31.9 - Building Services Piping; 2025.

I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.

J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).

L. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2018).

M. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

N. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017 (Reapproved 2025).

O. AWWA C606 - Grooved and Shouldered Joints; 2015.

P. MSS SP-45 - Bypass and Drain Connections; 2003 (Reaffirmed 2008).

Q. MSS SP-67 - Butterfly Valves; 2017.

R. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.

S. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2018.

T. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.

U. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.

V. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

W. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.

X. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

Y. MSS SP-125 - Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves; 2018.

Z. NSF 61 - Drinking Water System Components - Health Effects; 2024.

AA. NSF 372 - Drinking Water System Components - Lead Content; 2016.

1.05 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.

1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1. Obtain valves for each valve type from single manufacturer.
2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
5. Secure check valves in either the closed position or open position.
6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.
   a) Provide temporary inlet and outlet caps.
   b) Maintain caps in place until installation.
2. Store valves in shipping containers and maintain in place until installation.
   a) Store valves indoors in dry environment.
   b) Store valves off the ground in watertight enclosures when indoor storage is not an option.

1.08 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

A. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. See drawings for specific valve locations.

B. Provide the following valves for the applications if not indicated on drawings:

1. Shutoff: Ball, butterfly, gate or plug.
2. Dead-End: Single-flange butterfly (lug) type.
3. Throttling: Provide ball or butterfly.
4. Swing Check (Pump Outlet):
   a) 2 NPS and Smaller: Bronze swing check valves with bronze disc.
   b) 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.

C. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

D. Required Valve End Connections for Non-Wafer Types:

1. Copper Tube:
   a) 2 NPS and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   b) 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.

E. Domestic, Hot and Cold Water Valves:

1. 2 NPS and Smaller:
   a) Bronze: Provide with threaded ends.
   b) Ball: Two piece, full port, brass with stainless-steel trim.
   c) Bronze Swing Check: Class 125, bronze disc.
2. 2-1/2 NPS and Larger:
   a) Iron, 2-1/2 NPS to 4 NPS: Provide with flanged ends.
   b) Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
   c) Iron Swing Check: Class 125, metal seats.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:

1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
2. Handwheel: Valves other than quarter-turn types.
3. Hand Lever: Quarter-turn valves 6 NPS and smaller except plug valves.
4. Wrench: Plug valves with square heads.

D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:

1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.
4. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:

1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
5. Grooved End Connections: AWWA C606.

F. General ASME Compliance:

1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Solder-joint Connections: ASME B16.18.
3. Building Services Piping Valves: ASME B31.9.

G. Valve Materials for Potable Water: NSF 61 and NSF 372.

H. Bronze Valves:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

I. Valve Bypass and Drain Connections: MSS SP-45.

J. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRASS BALL VALVES

A. Two Piece, Full Port with Brass Trim:

1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Forged brass.
5. Ends: Threaded.
6. Seats: PTFE.
7. Stem: Brass.
8. Ball: Chrome-plated brass.

B. Three Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Forged brass.
5. Ends: Threaded.
6. Seats: PTFE or TFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.

2.04 BRONZE BALL VALVES

A. Two Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Bronze.
5. Ends: Threaded.
6. Seats: PTFE or TFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Manufacturers:
   a) Apollo Valves; _____.
   b) Nibco; T-585HP-66-lf.
   c) Watts LFB6080G2-SS.
   d) Webstone; H-x170.
   e) Jomar Valve; T-200
   f) Substitutions: See Section 01 6000 - Product Requirements.

2.05 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug type: Bi-directional dead-end service without use of downstream flange.

1. Comply with MSS SP-67, Type I.

2. CWP Rating: 200 psig.
3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
4. Stem: One or two-piece stainless steel.
5. Seat: EPDM.
6. Disc: Coated ductile iron.
7. Manufacturers:
    a) Apollo Valves: www.apollovalves.com/#sle.
    b) Jomar Valve; HPBFV series: www.jomarvalve.com.

2.06 BRONZE SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa) and Class 150: CWP Rating: 300 psig (2070 kPa).

1. Comply with MSS SP-80, Type 3.
2. Design: Horizontal flow.
3. Body: Bronze, lead-free, ASTM B62.
4. Ends: Threaded as indicated.
5. Disc: Bronze.
6. Manufacturers:
    a) Apollo Valves61YLF: www.apollovalves.com/#sle.
    b) Jomar Valves; T-511G: www.jomarvalve.com.
    c) Substitutions: See Section 01 6000 - Product Requirements.

2.07 IRON SWING CHECK VALVES

A. Class 125:

1. Comply with MSS SP-71, Type I.
2. CWP Rating: 200 psig.
3. Design: Clear or full waterway.
4. Body: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged as indicated.
6. Trim: Composition.
7. Seat Ring and Disc Holder: Bronze.
8. Disc: PTFE or TFE.
9. Gasket: Asbestos free.
10. Manufacturers:
    a) Apollo Valves: www.apollovalves.com/#sle.
    b) Ferguson Enterprises Inc: www.fnw.com/#sle.
    c) Substitutions: See Section 01 6000 - Product Requirements.

B. Class 250:

1. Comply with MSS SP-71, Type I.
2. CWP Rating: 500 psig.
3. Design: Clear or full waterway.
4. Body: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged as indicated.
6. Trim: Bronze.
7. Metal Seat.
8. Gasket: Asbestos free.

2.08 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125 with Lever and Spring-Closure Control.

1. Comply with MSS SP-71, Type I.
2. Description:
   a) CWP Rating: 200 psig.
   b) Design: Clear or full waterway.
   c) Body: ASTM A126, gray iron with bolted bonnet.
   d) Ends: Flanged as indicated.
   e) Trim: Bronze.
   f) Gasket: Asbestos free.
   g) Closer Control: Factory installed, exterior lever, and weight.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:

1. Lift Check: Install with stem plumb and vertical.
2. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION 22 0523

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other plumbing work.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

E. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014.

F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

I. MFMA-4 - Metal Framing Standards Publication; 2004.

J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.05 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems and thermal insulated pipe supports.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

D. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

E. Installer's Qualifications: Include evidence of compliance with specified requirements.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Installer Qualifications for Field-Welding: As specified in Section 05 5000.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with MSS SP-58.

2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a) Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b) Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    c) Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Materials for Metal Fabricated Supports: Comply with Section 05 5000.

C. Metal Channel (Strut) Framing Systems:

1. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
2. Comply with MFMA-4.
3. Channel Material:
    a) Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

D. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:
    a) Equipment Supports: 1/2 inch diameter.
    b) Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
    c) Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
    d) Trapeze Support for Multiple Pipes: 3/8 inch diameter.

E. Thermal Insulated Pipe Supports:

1. General Construction and Requirements:
    a) Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

b) Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
c) Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
d) Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.

2. PVC Jacket:
a) Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
b) Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
c) Thickness: 60 mil.

3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

F. Pipe Supports:

1. Liquid Temperatures Up To 122 degrees F:
a) Overhead Support: MSS SP-58 Types 1, 3 through 12.
b) Support From Below: MSS SP-58 Types 35 through 38.

2. Operating Temperatures from 122 to 446 degrees F:
a) Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.

G. Pipe Stanchions: For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.

H. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.

1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

I. Riser Clamps:

J. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

K. Strut Clamps: Two-piece pipe clamp.

L. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.

M. Pipe Hangers: For a given pipe run, use hangers of the same type and material.

1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

N. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
2. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
3. Pipe Diameter 8 inches: 0.625 inch U-bolt.
4. Pipe Diameter 10 inches: 0.75 inch U-bolt.
5. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
6. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

O. Pipe Alignment Guides: Galvanized steel.

1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
2. Pipe Diameter 10 inches and Larger: Roller type.

P. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

Q. Pipe Shields for Insulated Piping:

1. General Construction and Requirements:
   a) Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
   b) Shields Material: UV-resistant polypropylene with glass fill.
   c) Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
   d) Minimum Service Temperature: Minus 40 degrees F.
   e) Maximum Service Temperature: 178 degrees F.
   f) Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

R. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.

3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are permitted only as follows:
    a) Where approved by Architect.
11. Hammer-driven anchors and fasteners are not permitted.
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a) Comply with MFMA-4.
    b) Channel Material: Use galvanized steel.
    c) Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
    d) Manufacturer: Same as manufacturer of metal channel (strut) framing system.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

H. Equipment Support and Attachment:

1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

J. Secure fasteners according to manufacturer's recommended torque settings.

K. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 22 0529

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Control Panels: Nameplates.

B. Heat Transfer Equipment: Nameplates.

C. Piping: Pipe markers.

D. Small-sized Equipment: Tags.

E. Valves: Tags.

2.02 NAMEPLATES

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.
2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Plastic: Comply with ASTM D709.

2.03 TAGS

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.
2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.
2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Comply with ASME A13.1.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Color code as follows:

1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.
2. Compressed Air: Blue with white letters.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 9123 for stencil painting.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Section 09 9123.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Use tags on piping 3/4 inch diameter and smaller.

1. Identify service, flow direction, and pressure.
2. Install in clear view and align with axis of piping.
3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

3.03 SCHEDULES: INSTALL BELOW PER ANSI A13.1 STANDARDS

A. Equipment Type:

1. Identification: Name of Equipment
2. Background:
    a) Size:
    b) Color: Black
3. Lettering:
    a) Size:
    b) Color: White

B. Potable Water:

1. Background:
    a) Size: Per pipe OD
    b) Color: Green
2. Lettering:
    a) Size: Per pipe OD
    b) Color: White

C. Natural Gas/LP Gas:

1. Background:
    a) Size: Per pipe OD
    b) Color: Yellow
2. Lettering:
    a) Size: Per pipe OD
    b) Color: Black

D. Compressed Air:

1. Background:
    a) Size: Per pipe OD
    b) Color: Blue
2. Lettering:
    a) Size: Per pipe OD
    b) Color: White

END OF SECTION 22 0553

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Flexible removable and reusable blanket insulation.

C. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 09 9113 - Exterior Painting: Painting insulation jacket.

C. Section 09 9123 - Interior Painting: Painting insulation jacket.

D. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020.

D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Samples: Submit two samples of any representative size illustrating each insulation type.

D. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

A. Manufacturers:

1. Johns Manville Corporation; Micro-Lok: www.jm.com/#sle.
2. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: www.knaufinsulation.com/#sle.
3. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.

1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 650 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Fibrous Glass Fabric:

1. Cloth: Untreated; 9 oz/sq yd weight.
2. Blanket: 1.0 lb/cu ft density.
3. Weave: 5 by 5.

H. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd weight.

2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.

1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETS

A. PVC Plastic.

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
   a) Minimum Service Temperature: 0 degrees F.
   b) Maximum Service Temperature: 150 degrees F.
   c) Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
   d) Thickness: 10 mil.
   e) Connections: Brush on welding adhesive.

B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

E. Install cellular melamine with factory-applied jackets with a manufacturer-approved adhesive along seams, both straight lap joints and circumferential lap joints.

1. Install seal over seams with factory-approved room temperature vulcanization (RTV) silicone sealant to ensure a positive vapor barrier seal in outdoor and sanitary washdown environments.

F. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

G. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

3.03 SCHEDULES

A. Plumbing Systems:

1. Domestic Cold Water:
    a) Glass Fiber Insulation:
        1) Pipe Size Range: All Sizes.
            (a) Thickness: 1/2 inch.
2. Domestic Hot Water Supply and Hot Water Recirculation:
    a) Glass Fiber Insulation:
        1) Pipe Size Range: NPS 2" and Smaller.
            (a) Thickness: 1 inch.
        2) Pipe Size Range: NPS 2-1/2" and Larger.
            (a) Thickness: 1-1/2" inch.
3. Roof Drain Bodies:
    a) Sheet Elastomeric Insulation:
        1) Thickness: 1/2 inch.
4. Roof Drainage Above Grade: Horizonal runs only.
    a) Glass Fiber Insulation:
        1) Pipe Size Range: All sizes.
        2) Thickness: 1 inch.

END OF SECTION 22 0719

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.

1. Sanitary sewer.
2. Domestic water.
3. Storm water.
4. Flanges, unions, and couplings.
5. Pipe hangers and supports.
6. Manufactured sleeve-seal systems.
7. Valves.

1.02 RELATED REQUIREMENTS

A. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.

B. Section 22 0553 - Identification for Plumbing Piping and Equipment.

C. Section 22 0719 - Plumbing Piping Insulation.

D. Section 31 2316 - Excavation.

E. Section 31 2316.13 - Trenching.

F. Section 31 2323 - Fill.

G. Section 33 0110.58 - Disinfection of Water Utility Piping Systems.

1.03 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 2015.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

D. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; 2016.

E. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; 2017.

F. ASME B31.9 - Building Services Piping; 2025.

G. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2019.

H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.

I. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems; 2009.

J. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2020.

K. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

L. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.

M. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

O. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2013.

P. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

Q. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.

R. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020.

S. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012 (Reapproved 2018).

T. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

U. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).

V. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.

W. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.

X. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.

Y. AWWA C651 - Disinfecting Water Mains; 2014.

Z. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2017 (Revised 2018).

AA. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2012 (Revised 2018).

BB. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.

CC. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

DD. MSS SP-67 - Butterfly Valves; 2017.

EE. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

FF. NSF 61 - Drinking Water System Components - Health Effects; 2024.

GG. NSF 372 - Drinking Water System Components - Lead Content; 2016.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Welder Certificate: Include welders certification of compliance with ASME BPVC-IX.

D. Project Record Documents: Record actual locations of valves.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

B. 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. Waste, Force-Main Piping: 50 psig.

C. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

D. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) [endif]and listed by NSF International.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.

1. Fittings: Cast iron.
2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets. .
3. Tensile Strength: 21,000 psig minimum.

4. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute [endif]® and listed by NSF International.
5. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer's registered trademark by which the manufacturer can be readily identified after installation.

B. High Performance Coated Hub-And-Spigot, Cast-Iron Soil Pipe and Fittings.

1. Pipe and Fittings: ASTM A 74, Service Class.
2. Gaskets: ASTM C 564, rubber.
3. Tensile Strength: 21,000 psig minimum.
4. All cast-iron soil pipe and fitting shall be marked with the collectdive trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.
5. Each length of pipe and each fitting shallo be plainly marked with size, country of origin, and name of manufacturer, or manufacturer's registered trademark by which the manufacturer can be readily identified after installation.
6. The inside of each pipe shall be reamed prior to coating to decrease the coefficient of friction.
7. Pipe coating of both ID and OD: Chemically deposited zinc-phosphate pretreatment layer followed by and electrically deposited, high performance cathodic epoxy coating, and finally an electrically deposited, high performance anodic epoxy topcoat. Coating thickness shall be 5 mils or greater on both the OD and ID.
8. Fitting coating on both ID and OD: Chemically deposited zinc-phosphate pretreatment layer followed by an electrically deposited, high performance cathodic epoxy coating and finally an epoxy acrylic powder topcoat. Coating thickness shall be 5 mils or greater on both the OD and ID.
9. Coating performance: Pipe and Fitting Coating must pass the following performance specifications per EN 877:
   a) 350 hours of salt spray testing
   b) Resistance to wastewater for 30 days at 73°F
   c) Chemical resistance from pH 2 to pH 12 for 30 days at 73°F
   d) Resistance to hot water for 24 hours at 203°F

C. PVC Pipe: ASTM D2665 or ASTM D3034.

1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.

2. Joints: ASTM A 888 and CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
3. CISPI, Hubless-Piping Couplings:
   a) Manufacturers: Subject to compliance with requirements. Provide products by one of the following:
      1) a. Ideal Tridon
      2) b. ANACO-Husky
      3) c. Tyler Couplings
      4) d. Mission Rubber Company
   b) Standards: ASTM C 1277 and CISPI 310.
   c) Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop. Couplings shall bear the trademark NSF International.
   d) Couplings in "Heavy-Duty, Hubless-Piping Couplings" Paragraph below are made in NPS 1-1/2 to NPS 15.
   e) Heavy-Duty, Hubless-Piping Couplings:
      1) Manufacturers: Subject to compliance with requirements. Provide products by one of the following:
         (a) a. Ideal Tridon
         (b) b. ANACO-Husky
         (c) c. Tyler Couplings
         (d) d. Mission Rubber Company
      2) Standards: ASTM C 1540.
      3) Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

B. Copper Tube: ASTM B306, DWV.

1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, sovent.
2. Joints: ASTM B32, alloy Sn50 solder.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, Type K, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
2. Joints: AWS A5.8M/A5.8, BCuP copper/silver braze.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.
3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
    a) Manufacturers:
        1) Anvil International; _____: www.anvilintl.com/#sle.
        2) Apollo Valves; _____: www.apollovalves.com/#sle.
        3) Grinnell Products; _____: www.grinnell.com/#sle.
        4) Viega LLC; _____: www.viega.us/#sle.

2.06 STORM WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.

1. Fittings: Cast iron.
2. Joint Seals: ASTM C564 neoprene gaskets.
3. Tensile Strength: 21,000 psig minimum.
4. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF International.Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer's registered trademark by which the manufacturer can be readily identified after installation.
5. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer's registered trademark by which the manufacturer can be readily identified after installation.

2.07 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.
2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
    a) CISPI, Hubless-Piping Couplings:
    b) Manufacturers: Subject to compliance with requirements. Provide products by one of the following:
        1) Ideal Tridon
        2) ANACO-Husky
        3) Tyler Couplings
        4) Mission Rubber Company
    c) Standards: ASTM C 1277 and CISPI 310.

d) Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop. Couplings shall bear the trademark NSF International.
e) Couplings in "Heavy-Duty, Hubless-Piping Couplings" Paragraph below are made in NPS 1-1/2 to NPS 15 .
f) Heavy-Duty, Hubless-Piping Couplings:
g) Manufacturers: Subject to compliance with requirements. Provide products by one of the following:
    1) Ideal Tridon
    2) ANACO-Husky
    3) Tyler Couplings.
    4) Mission Rubber Company.
h) Standards: ASTM C 1540.Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.08 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.

B. Plumbing Piping - Drain, Waste, and Vent:

1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
3. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
4. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
5. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:

1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

3. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
4. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
5. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
3. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.09 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Modular/Mechanical Seal:

1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
2. Provide watertight seal between pipe and wall/casing opening.
3. Elastomer element size and material in accordance with manufacturer's recommendations.
4. Glass reinforced plastic pressure end plates.

2.10 BALL VALVES

A. Manufacturers:

1. Apollo Valves; _____: www.apollovalves.com/#sle.
2. Nibco, Inc; _____: www.nibco.com/#sle.
3. Jomar Valves.
4. Watts Waterworks

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.11 BUTTERFLY VALVES

A. Manufacturers:

1. Apollo Valves: www.apollovalves.com/#sle.
2. Crane Company: www.cranecpe.com/#sle.

3. Jomar Valves.

B. Construction 1-1/2 Inches and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

C. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.12 PIPING SPECIALTIES

A. Flow Controls:

1. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
2. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.13 WATER PRESSURE REDUCING VALVES

A. Up to 2 Inches:

1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.

B. Over 2 Inches:

1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.14 RELIEF VALVES

A. Temperature and Pressure:

1. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

2.15 STRAINERS

A. Size 2 Inches and Under:

1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 1-1/2 inch to 4 inches:

1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Buried CPVC and PVC pipe shall be installed in accordance with ASTM D 2321 and ASTM F 1668.

C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

D. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

E. Install piping to maintain headroom, conserve space, and not interfere with use of space.

F. Group piping whenever practical at common elevations.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.

H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

1. Refer to Section 22 0719.

I. Provide access where valves and fittings are not exposed.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

L. Install bell and spigot pipe with bell end upstream.

M. Install valves with stems upright or horizontal, not inverted. Refer to Section 22 0523.

N. Install water piping to ASME B31.9.

O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

P. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

Q. Sleeve pipes passing through partitions, walls, and floors.

R. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

S. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.
8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
9. Support cast iron drainage piping at every joint.

T. Manufactured Sleeve-Seal Systems:

1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a watertight seal.
6. Install in accordance with manufacturer's recommendations.

U. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Install globe valves for throttling, bypass, or manual flow control services.

E. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 33 0110.58.

B. Prior to starting work, verify system is complete, flushed, and clean.

C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.

3.08 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:
   a) Pipe Size: 1/2 inches to 1-1/4 inches:
      1) Maximum Hanger Spacing: 6.5 ft.
      2) Hanger Rod Diameter: 3/8 inches.
   b) Pipe Size: 1-1/2 inches to 2 inches:
      1) Maximum Hanger Spacing: 10 ft.
      2) Hanger Rod Diameter: 3/8 inch.
   c) Pipe Size: 2-1/2 inches to 3 inches:
      1) Maximum Hanger Spacing: 10 ft.
      2) Hanger Rod Diameter: 1/2 inch.

END OF SECTION 22 1005

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Drains.

B. Cleanouts.

C. Hose bibbs.

D. Hydrants.

E. Backflow preventers.

F. Water hammer arrestors.

G. Mixing valves.

1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

B. Section 22 3000 - Plumbing Equipment.

C. Section 22 4000 - Plumbing Fixtures.

1.03 REFERENCE STANDARDS

A. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2009.

B. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.

C. NSF 61 - Drinking Water System Components - Health Effects; 2024.

D. NSF 372 - Drinking Water System Components - Lead Content; 2016.

E. PDI-WH 201 - Water Hammer Arresters; 2017.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

E. Manufacturer's Qualification Statement.

F. Operation Data: Indicate frequency of treatment required for interceptors.

G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

H. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

B. Refer to plumbing schedules on drawings for piping specialties requirements not defined in this section.

2.02 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers:

1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.03 DOUBLE CHECK VALVE ASSEMBLIES

A. Manufacturers:

1. Substitutions: See Section 01 6000 - Product Requirements.

B. Double Check Valve Assemblies:

1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.04 WATER HAMMER ARRESTORS

A. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.05 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
2. Accessories:
   a) Check valve on inlets.
   b) Volume control shut-off valve on outlet.
   c) Stem thermometer on outlet.
   d) Strainer stop checks on inlets.

2.06 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.07 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

C. Washer Type:

1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.08 FLOOR DRAIN TRAP SEALS

A. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F. Pipe relief from backflow preventer to nearest drain.

G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to fixture.

END OF SECTION 22 1006

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Water Heaters:

B. In-line circulator pumps.

1.02 RELATED REQUIREMENTS

A. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
2. Indicate pump type, capacity, power requirements.
3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
4. Provide electrical characteristics and connection requirements.

C. Shop Drawings:

1. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

D. Project Record Documents: Record actual locations of components.

E. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Certifications:

C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 - PRODUCTS

2.01 WATER HEATERS

2.02 IN-LINE CIRCULATOR PUMPS

A. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.

B. Impeller: Noryl.

C. Shaft: Ceramic with integral thrust collar and two oil lubricated bronze sleeve bearings.

D. Seal: Carbon rotating against a stationary ceramic seat.

E. Drive: Flexible coupling.

2.03 ELECTRICAL WORK

A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.

B. Electrical characteristics to be as specified or indicated.

C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.

D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Pumps:

1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION 22 3000

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Water closets.

B. Urinals.

C. Lavatories.

D. Sinks.

E. Mop sinks.

F. Showers.

1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

B. Section 22 1006 - Plumbing Piping Specialties.

C. Section 22 3000 - Plumbing Equipment.

D. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration.; 2013.

C. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

D. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.

E. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2017).

F. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2018.

G. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2018.

H. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018.

I. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2017.

J. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2017.

K. ASSE 1014 - Performance Requirements for Backflow Prevention Devices for Hand-Held Showers; 2005.

L. FM (AG) - FM Approval Guide; Current Edition.

M. NSF 61 - Drinking Water System Components - Health Effects; 2024.

N. NSF 372 - Drinking Water System Components - Lead Content; 2016.

O. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Instructions: Indicate installation methods and procedures.

D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for electric water cooler.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

B. Refer to plumbing schedules on plumbing drawings for fixture requirements.

2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for installation of plumbing systems.

B. Comply with UL (DIR) requirements.

C. Perform work in accordance with local health department regulations.

D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.03 REFER TO THE SCHEDULES ON THE DRAWINGS.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports and bolts.

E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

A. Clean plumbing fixtures and equipment.

3.07 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Do not permit use of fixtures by construction personnel.

C. Repair or replace damaged products before Date of Substantial Completion.

3.08 SCHEDULES

A. Fixture Heights: Install fixtures to heights above finished floor as indicated.

1. Water Closet:
   a) Standard: 15 inches to top of bowl rim.
   b) Accessible: 18 inches to top of seat.
2. Water Closet Flush Valves:
   a) Standard: 11 inches min. above bowl rim.
   b) Recessed: 10 inches min. above bowl rim.
3. Urinal:
   a) Standard: 22 inches to top of bowl rim.
   b) Accessible: 17 inches to top of bowl rim.
4. Lavatory:
   a) Standard: 31 inches to top of basin rim.
   b) Accessible: 34 inches to top of basin rim.
5. Drinking Fountain:
   a) Child: 30 inches to top of basin rim.
   b) Standard Adult: 40 inches to top of basin rim.
   c) Accessible: 36 inches to top of spout.
6. Shower Heads:
   a) Adult Male: 69.5 inches to bottom of head.
   b) Adult Female: 64.5 inches to bottom of head.
   c) Child: 58.5 inches to bottom of head.
7. Emergency Eye and Face Wash:
   a) Standard: 38 inches to receptor rim.
8. Emergency Shower:
   a) Standard: 84 inches to bottom of head.

B. Fixture Rough-In

1. Water Closet (Flush Valve Type):
   a) Cold Water: 1 Inch.
   b) Waste: 4 Inch.
   c) Vent: 2 Inch.
2. Water Closet (Tank Type):
   a) Cold Water: 1/2 Inch.
   b) Waste: 4 Inch.
   c) Vent: 2 Inch.

3. Urinal (Flush Valve Type):
    a) Cold Water: 3/4 Inch.
    b) Waste: 2 Inch.
    c) Vent: 2 Inch.
4. Lavatory:
    a) Hot Water: 3/8 Inch.
    b) Cold Water: 3/8 Inch.
    c) Waste: 1-1/4 Inch.
    d) Vent: 2 Inch.
5. Sink:
    a) Hot Water: 1/2 Inch.
    b) Cold Water: 1/2 Inch.
    c) Waste: 1-1/2 Inch.
    d) Vent: 2 Inch.
6. Service Sink:
    a) Hot Water: 1/2 Inch.
    b) Cold Water: 1/2 Inch.
    c) Waste: 3 Inch.
    d) Vent: 1-1/2 Inch.
7. Drinking Fountain:
    a) Cold Water: 1/2 Inch.
    b) Waste: 1-1/4 Inch.
    c) Vent: 2 Inch.
8. Bathtub:
    a) Hot Water: 1/2 Inch.
    b) Cold Water: 1/2 Inch.
    c) Waste: 1-1/2 Inch.
    d) Vent: 2 Inch.
9. Shower:
    a) Hot Water: 1/2 Inch.
    b) Cold Water: 1/2 Inch.
    c) Waste: 2 Inch.
    d) Vent: 2 Inch.

END OF SECTION 22 4000

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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 supplementary general requirements for the following :

1. Codes and Standards
2. Conflicting Requirements
3. Specifications and Drawing Conventions
4. Fees, Permits, and Inspection
5. Submittals
6. Closeout Submittals
7. Quality Assurance
8. Product Delivery, Storage, and Handling
9. Product Warranties
10. Product Selection Procedures
11. Delegated Design
12. Coordination Drawings
13. Emergency, Operation, and Maintenance Manuals
14. Construction Waste
15. General Coordination for HVAC Work
16. Cutting and Patching
17. Painting

1.03 DEFINITIONS

A. "Action Submittals": Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Basis-of-Design Product": A product in which a specific manufacturer's product is named on the drawings or is accompanied by the words "basis-of-design product" in the specifications, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

D. "Construction Waste": Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

E. "Cutting": Removal of in-place construction necessary to permit installation or performance of other work.

F. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

G. "Disposal": Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

H. "File Transfer Protocol (FTP)": Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

I. "Furnish": To supply, deliver, unload, and inspect for damage.

J. "General": Basic Contract definitions are included in the Conditions of the Contract.

K. "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."

L. "Informational Submittals": Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

M. "Install": To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

N. "Patching": Fitting and repair work required to restore construction to original conditions after installation of other work.

O. "Portable Document Format (PDF)": An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

P. "Product": Material, machinery, components, equipment, fixtures,and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Product may be new, never before used, or re-used materials or equipment.

Q. "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.

R. "Provide": Furnish and install, complete and ready for the intended use.

S. "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.

T. "Salvage": Recovery of demolition and construction waste and subsequent sale or reuse in another facility.

U. "Salvage and Reuse": Recovery of demolition and construction waste and subsequent incorporation into the Work.

V. "System": An organized collection of parts, equipment, or subsystems united by regular interaction.

W. "Subsystem": A portion of a system with characteristics similar to a system.

1.04 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 in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AABC	Associated Air Balance Council	(202) 737-0202
	www.aabchq.com	
AGA	American Gas Association	(202) 824-7000
	www.aga.org	
AHRI	Air Conditioning, Heating, and Refrigeration Institute	(703) 524-8800
	www.ahrinet.org	
AIA	American Institute of Architects (The)	(800) 242-3837
	www.aia.org	(202) 626-7300
AMCA	Air Movement and Control Association International, Inc.	(847) 394-0150

	www.amca.org	
ANSI	American National Standards Institute	(202) 293-8020
	www.ansi.org	
ARI	Air-Conditioning & Refrigeration Institute	(703) 524-8800
	www.ari.org	
ASCE	American Society of Civil Engineers	(800) 548-2723
	www.asce.org	(703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers	(800) 527-4723
	www.ashrae.org	(404) 636-8400
ASME	ASME International	(800) 843-2763
	(American Society of Mechanical Engineers International)	(973) 882-1170
	www.asme.org	
ASTM	ASTM International	(610) 832-9500
	(American Society for Testing and Materials International)	
	www.astm.org	
AWS	American Welding Society	(800) 443-9353
	www.aws.org	(305) 443-9353
CGA	Compressed Gas Association	(703) 788-2700
	www.cganet.com	
CIMA	Cellulose Insulation Manufacturers Association	(888) 881-2462
	www.cellulose.org	(937) 222-2462
CSI	Construction Specifications Institute (The)	(800) 689-2900
	www.csinet.org	(703) 684-0300
CTI	Cooling Technology Institute	(281) 583-4087
	www.cti.org	

EJMA	Expansion Joint Manufacturers Association, Inc.	(914) 332-0040
	www.ejma.org	
HI	Hydronics Institute	(908) 464-8200
	www.gamanet.org	
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association	(908) 464-8200
	Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI)	
	www.ahrinet.org	
IGMA	Insulating Glass Manufacturers Alliance	(613) 233-1510
	www.igmaonline.org	
ISA	Instrumentation, Systems, and Automation Society, The	(919) 549-8411
	www.isa.org	
ISO	International Organization for Standardization	41 22 749 01 11
	www.iso.ch	
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.	(703) 281-6613
	www.mss-hq.com	
NADCA	National Air Duct Cleaners Association	(202) 737-2926
	www.nadca.com	
NEBB	National Environmental Balancing Bureau	(301) 977-3698
	www.nebb.org	
NEMA	National Electrical Manufacturers Association	(703) 841-3200
	www.nema.org	
NFPA	NFPA	(800) 344-3555
	(National Fire Protection Association)	(617) 770-3000
	www.nfpa.org	

SMACNA	Sheet Metal and Air Conditioning Contractors' Natio nal Association	(703) 803-2980
	www.smacna.org	
STI	Steel Tank Institute	(847) 438-8265
	www.steeltank.com	
TEMA	Tubular Exchanger Manufacturers Association	(914) 332-0040
	www.tema.org	
UL	Underwriters Laboratories Inc.	(877) 854-3577
	www.ul.com	(847) 272-8800
USGBC	U.S. Green Building Council	(800) 795-1747
	www.usgbc.org	

B. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ICC	International Code Council	(888) 422-7233
	www.iccsafe.org	

C. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DOE	Department of Energy	(202) 586-9220
	www.energy.gov	

EPA	Environmental Protection Agency	(202) 272-0167
	www.epa.gov	
FCC	Federal Communications Commission	(888) 225-5322
	www.fcc.gov	
OSHA	Occupational Safety & Health Administration	(800) 321-6742
	www.osha.gov	(202) 693-1999
PHS	Office of Public Health and Science	(202) 690-7694
	http://www.hhs.gov/ophs/	
USP	U.S. Pharmacopeia	(800) 227-8772
	www.usp.org	
USPS	Postal Service	(202) 268-2000
	www.usps.com	

D. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA)	(800) 872-2253
CFR	Code of Federal Regulations	(866) 512-1800
	Available from Government Printing Office	(202) 512-1800
	www.gpoaccess.gov/cfr/index.html	

1.05 CODES AND STANDARDS

A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific

code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.

B. Applicable codes and standards shall include all state laws, local ordinances, utility company regulations, and the applicable requirements of the following adopted codes and standards.

1. Building Codes for Arkansas
    a) Arkansas Fire Prevention Code 2021
    b) National Electrical Code 2020
    c) Arkansas Fuel Gas Code 2018
    d) Arkansas Energy Code 2011 (based on ANSI/ASHRAE/IESNA Standard 90.1-2007)
    e) Arkansas State Plumbing Code 2018
    f) International Mechanical Code 2021

1.06 CONFLICTING REQUIREMENTS

A. Conflicting requirements: If compliance with standards, codes, regulations, and specifications establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision 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 Engineer for a decision before proceeding.

1.07 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. 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. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
4. The HVAC Drawings show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to the requirements shown on all of the drawings. General and Structural Drawings shall take precedence over HVAC Drawings. Because of the small scale of the HVAC Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, offsets, valves and accessories as may be required to meet such conditions.

1.08 FEES, PERMITS, AND INSPECTIONS

A. All required fees, permits and inspections of all kind shall be obtained and paid for by the Contractor under the section of the specifications for which they are required.

B. Certificate of Final Inspection: Under each applicable section of the specifications, the Contractor shall, upon completion of the work under that section, furnish a certificate of final inspection to the Engineer from the inspection department having jurisdiction.

1.09 SUBMITTALS

A. Submittal Schedule

1. Submit a schedule 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 Engineer and additional time for handling and reviewing submittals required by those corrections.
    a) Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
    b) Initial Submittal: 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.
    c) Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
        1) Submit revised submittal schedule to reflect changes in current status and timing for submittals.
    d) Format: Arrange the following information in a tabular format:
        1) Scheduled date for first submittal.
        2) Specification Section number and title.
        3) Submittal category: Action; informational.
        4) Name of subcontractor.
        5) Description of the Work covered.
        6) Scheduled date for Engineer's final release or approval.

B. Submittal Administrative Requirements

1. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
    a) Submit submittals to Engineer through the Architect.
    b) Engineer, through Architect, will return annotated file.
2. Digital Data Files:

a) Electronic digital data files of the Project drawings may be provided by Engineer for Contractor's use in preparing submittals.
b) Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer's Release Form. A signed release form and any payment required must be returned to the Engineer prior to the transmission of an electronic digital data files.
c) Electronic digital data file formats may include AutoCAD drawings, Revit converted to AutoCAD drawings, or Revit model.

3. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   a) Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   b) Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
   c) Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   d) Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      1) Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
4. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer'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.
   a) Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
   b) Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   c) Resubmittal Review: Allow 14 days for review of each resubmittal.
5. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
   a) 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.

b) Name file with submittal number or other unique identifier, including revision identifier.
    1) File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
c) Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
d) Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
    1) Project name.
    2) Name and address of Architect.
    3) Name and address of Engineer.
    4) Name of Contractor.
    5) Name of firm or entity that prepared submittal.
    6) Names of subcontractor, manufacturer, and supplier.
    7) Category and type of submittal.
    8) Submittal purpose and description.
    9) Specification Section number and title.
    10) Specification paragraph number or drawing designation and generic name for each of multiple items.
    11) Drawing number and detail references, as appropriate.
    12) Location(s) where product is to be installed, as appropriate.
    13) Related physical samples submitted directly.
    14) Indication of full or partial submittal.
    15) Transmittal number.
    16) Submittal and transmittal distribution record.
    17) Other necessary identification.
    18) Remarks.
e) Metadata: Include the following information as keywords in the electronic submittal file metadata:
    1) Project name.
    2) Number and title of appropriate Specification Section.
    3) Manufacturer name.
    4) Product name.

6. Options: Identify options requiring selection by Engineer.
7. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations

from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

8. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
    a) Note date and content of previous submittal.
    b) Note date and content of revision in label or title block and clearly indicate extent of revision.
    c) Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
9. 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.
10. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.
11. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
    a) Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
    b) Engineer’s Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor through Architect of approval or rejection of proposed comparable product request within 14 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
        1) Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

1.10 CLOSEOUT SUBMITTALS

A. Closeout submittals shall include, but not limited to, the following:

1. Operation and Maintenance Materials
2. Final Approved Submittals

B. Operation and Maintenance Materials Submittals

1. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals.

Submit reviewed manual content formatted and organized as required by this Section.

a) Engineer will comment on whether content of operations and maintenance submittals are acceptable.
b) Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

2. Format: Submit operations 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 Engineer.
      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.
   b) In addition to the electronic submit provide two paper copies of the corrected final submittal as part of the "Closeout Documents". Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer, through Architect, will return two copies. The two paper copies will be provided to the Owner as part of the "Closeout Documents"
3. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 days before commencing demonstration and training. Engineer will return copy with comments.
   a) Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

C. 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 not suitable 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 showing factory-installed wiring.
   b) Printed performance curves.
   c) Operational range diagrams.
   d) Clearances required to other construction, if not indicated on accompanying Shop Drawings.

D. Shop Drawings: Prepare Project-specific information, drawn accurately to scale and sufficiently large to show all pertinent features of the item, method of connections, and notations clearly legible. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.

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.

E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."

F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."

G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."

H. Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."

I. 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 Engineers and owners, and other information specified.

J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

K. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

N. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

O. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

P. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

Q. Pre-construction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

R. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

S. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

1.11 QUALITY ASSURANCE

A. Products:

1. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
   a) Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.

b) If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.12 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project Site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage..
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.13 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and

limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submit warranties in accordance with "Closeout Procedures."

1.14 FIELD CONDITIONS

A. The Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

1.15 WARRANTY

A. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the HVAC under guarantees outlined above for a period of 1 full year after acceptance by the Engineer and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for 1 full year after final acceptance by the Engineer.

PART 2 PRODUCTS

2.01 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 Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit 2 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.

2.02 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Were two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
4. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
5. Where products are accompanied by the term "as selected," Architect will make selection.

6. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
7. Products containing asbestos shall not be used.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
   a) Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
   b) Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
   a) Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
   b) Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Selection Procedure: Where Specifications include the phrase "as selected by Architect" or similar phrase, select a product that complies with requirements. Architect will select option from manufacturer's product line that includes both standard and premium items.

D. Comparable Products

1. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
   a) Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   b) Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   c) Evidence that proposed product provides specified warranty.
   d) List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   e) Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections,

2.03 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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. Include the following information, as applicable:

a) Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b) Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c) Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d) Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e) Show location and size of access doors required for access to concealed valves and other controls.
f) Indicate required installation sequences.
g) Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, low voltage, and electrical work. Show locations of visible ceiling mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical, plumbing,fire protection, low voltage, and electrical equipment, and related work.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, low voltage, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Mechanical and Plumbing Work: Show the following:
   a) Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b) Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c) Fire-rated enclosures around ductwork.
6. Electrical Work: Show the following:

a) Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
b) Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
c) Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
d) Location of pull boxes and junction boxes, dimensioned from column center lines.

7. Fire-Protection System: Show the following:
   a) Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
8. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: DXF operating in Microsoft Windows operating system.
2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and supply Portable Data File (PDF) format.

2.04 EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. 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.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

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."

F. 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.

G. 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: Enable bookmarking of 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.

H. Operation Manual

1. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   a) System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.

b) Performance and design criteria if Contractor has delegated design responsibility.
c) Operating standards.
d) Operating procedures.
e) Operating logs.
f) Wiring diagrams.
g) Control diagrams.
h) Piped system diagrams.
i) Precautions against improper use.
j) License requirements including inspection and renewal dates.

2. Descriptions: Include the following:
   a) Product name and model number. Use designations for products indicated on Contract Documents.
   b) Manufacturer's name.
   c) Equipment identification with serial number of each component.
   d) Equipment function.
   e) Operating characteristics.
   f) Limiting conditions.
   g) Performance curves.
   h) Engineering data and tests.
   i) Complete nomenclature and number of replacement parts.
3. Operating Procedures: 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) Instructions on stopping.
   f) Normal shutdown instructions.
   g) Seasonal and weekend operating instructions.
   h) Required sequences for electric or electronic systems.
   i) Special operating instructions and procedures.
4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

I. Maintenance Manuals

1. Content: Organize manual into a separate section for each product, system, subsystem, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
2. Source Information: List each product, system, or subsystem 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.

3. Product Information: Include the following, as applicable:
   a) Product name and model number.
   b) Manufacturer's name.
   c) Color, pattern, and texture.
   d) Material and chemical composition.
   e) Reordering information for specially manufactured products.
   f) Standard maintenance instructions and bulletins.
   g) Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   h) Identification and nomenclature of parts and components.
   i) List of items recommended to be stocked as spare parts.
4. Maintenance Procedures: Include manufacturer's written recommendations and 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) Schedule for routine cleaning and maintenance.
   e) Repair instructions.
   f) Test and inspection instructions.
   g) Troubleshooting guide.
   h) Precautions against improper maintenance.
   i) Disassembly; component removal, repair, and replacement; and reassembly instructions.
   j) Aligning, adjusting, and checking instructions.
   k) Demonstration and training video recording, if available.
5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
6. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   a) Include procedures to follow and required notifications for warranty claims.
7. 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.
   a) Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

b) Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

8. 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.
9. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
10. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
    a) Include procedures to follow and required notifications for warranty claims.

PART 3 EXECUTION

3.01 CONTRACTOR'S SUBMITTAL REVIEW

A. Action 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. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.02 ENGINEER'S SUBMITTAL ACTION

A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to the Architect to forward to the 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 Engineer.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

3.03 CONSTRUCTION WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Disposal: Remove waste materials from Owner's property and legally dispose of them

3.04 GENERAL COORDINATION FOR HVAC WORK

A. The Contractor shall compare the HVAC Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the HVAC Work. The HVAC Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a

failure to coordinate the work with other trades shall be made by the Contractor at his own expense.

B. Anchor bolts, sleeves, inserts and supports that may be required for the HVAC Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.

C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.

D. Locations of pipes, ductwork, equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe and duct prior to fabrication.

1. Right-of-Way: Lines which pitch shall have the right of way over those which do not pitch. For example: plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
2. Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not

indicated on the drawings. The Contractor shall furnish and install all traps, air vents, sanitary vents, etc., as required to effect these offsets, transitions and changes in direction.

3. Installation and Arrangement: The Contractor shall install all HVAC Work to permit removal (without damage to other parts) of coils, heat exchanger bundles, fan shafts and wheels, filters, belt guards, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes, ducts, and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.
4. Ductwork: The Contractor shall change the cross-sectional dimensions of ductwork when required to meet job conditions but shall maintain at least the same equivalent cross-sectional area. The Contractor shall secure the approval of the Engineer prior to fabrication of ductwork requiring such changes.
5. Access: The Contractor shall provide all necessary access panels in walls, ceilings, equipment, ducts. etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.

E. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in piping, ductwork, supports, insulation, etc. The Contractor shall provide any additional valves, fittings, and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

F. Connections: All piping connecting to equipment shall be installed without strain at the piping connection

G. Inaccessible Equipment

1. Where the Engineer or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

H. Electrical Coordination

1. Power: All power and motor wiring shall be performed under Division 26 unless otherwise noted for specific items. Control and interlock wiring shall be done by the Contractor of this Division.
2. Starters and Drives: All motor starters and drives unless included in other sections of the specifications shall be by Division 26. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.
3. Disconnects: All equipment furnished under this Division required to have a means of disconnect shall be supplied with a disconnect or a disconnect shall be furnished and installed by Division 26. The Contractor shall coordinate between this Division and Division 26 to ensure that all disconnects required for the Project are furnished and installed.
4. The Contractor of this Division shall furnish and install any low voltage relays, pressure switches, and similar items required for the proper operation of the HVAC equipment.

I. Dedicated Electrical Space: The space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone. The area above the dedicated space shall be permitted to contain foreign systems, provided protection is installed to avoid damage

to the electrical equipment from condensation, leaks or breaks in foreign systems. Every effort shall be made to eliminate foreign systems above equipment to the structural ceiling. If this is not possible, the Contractor shall encase any pipe in a second pipe with a minimum number of joints. Provide 18 gauge (minimum) galvanized, 4 inch (minimum) deep drain pans under piping and ductwork located or passing over electrical equipment. Pipe 1" drain from pan to nearest floor drain. Drain pan shall be adequately supported and constructed to hold 4 inches of water without collapse.

J. Lubrication: The Contractor shall be held responsible for all damage to bearings while the equipment is being operated up to the date of acceptance of the equipment. The Contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. Pump shafts, fan shafts, motor shafts, etc. shall be coated to prevent deterioration in moist or wet atmospheres.

3.05 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Under each section of the specifications, the Contractor shall be responsible for all required cutting, etc., incident to his work under that section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any major structural element, beam or column.
2. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades because of fault, error or tardiness or because of any damage done by own workmanship.

3. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Proceed with patching after construction operations requiring cutting are complete.

D. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    a) Clean piping and similar features before applying paint or other finishing materials.

b) Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a) Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

E. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.06 PAINTING

A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications.

Contractor shall paint equipment, piping, etc., in accordance with Division 9.

Equipment specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.

B. Apply paint to exposed piping according to the following, unless otherwise indicated:

1. Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
2. Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include 2 finish coats over galvanized metal primer.
3. Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
4. Do not paint piping specialties with factory-applied finish.
5. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

6. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

END OF SECTION 23 0000

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

E. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

1. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
    a) Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.

B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

1. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
2. Comply with MFMA-4.
3. Channel Material:
    a) Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:
    a) Equipment Supports: 1/2 inch diameter.
    b) Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
    c) Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Thermal Insulated Pipe Supports:

1. General Construction and Requirements:
    a) Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    b) Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    c) Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
    d) Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
2. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

E. Pipe Supports:

1. Liquid Temperatures Up To 122 degrees F:
    a) Overhead Support: MSS SP-58 Types 1, 3 through 12.
    b) Support From Below: MSS SP-58 Types 35 through 38.
2. Operating Temperatures from 122 to 446 degrees F:

a) Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
b) Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
c) Sliding Support: MSS SP-58 Types 35 through 38.

F. Pipe Stanchions: For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.

G. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.

1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

H. Riser Clamps:

1. Provide copper plated clamps for copper tubing support.
2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

I. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

1. Manufacturers:
a) Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

J. Strut Clamps: Two-piece pipe clamp.

1. Manufacturers:
a) Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

K. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.

1. Manufacturers:
a) Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

L. Pipe Hangers: For a given pipe run, use hangers of the same type and material.

1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.

2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

M. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.

N. Pipe Alignment Guides: Galvanized steel.

1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.

O. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

P. Pipe Shields for Insulated Piping:

1. Manufacturers:
   a) Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. General Construction and Requirements:
   a) Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
   b) Shields Material: UV-resistant polypropylene with glass fill.
   c) Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
   d) Minimum Service Temperature: Minus 40 degrees F.
   e) Maximum Service Temperature: 178 degrees F.
   f) Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
4. Steel: Use beam clamps, machine bolts, or welded threaded studs.
5. Sheet Metal: Use sheet metal screws.
6. Plastic and lead anchors are not permitted.
7. Powder-actuated fasteners are not permitted.
8. Hammer-driven anchors and fasteners are not permitted.
9. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
   a) Comply with MFMA-4.
   b) Channel Material: Use galvanized steel.
   c) Manufacturer: Same as manufacturer of metal channel (strut) framing system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Do not penetrate or otherwise notch or cut structural members without approval of Architect.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:

1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 23 0529

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Seismic control requirements.

1. Includes requirements for seismic qualification of equipment not specified in this section.

C. Vibration-isolated equipment support bases.

D. Vibration isolators.

E. External seismic snubber assemblies.

F. Seismic restraint systems.

1.02 DEFINITIONS

A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).

F. MFMA-4 - Metal Framing Standards Publication; 2004.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Seismic Controls:
   a) Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
   b) Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.05 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

2. Seismic Controls: Include seismic load capacities.

C. Shop Drawings - Vibration Isolation Systems:

1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.

D. Shop Drawings - Seismic Controls:

1. Include dimensioned plan views and sections indicating proposed HVAC component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
2. Identify mounting conditions required for equipment seismic qualification.
3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
4. Indicate proposed arrangement of distributed system trapeze support groupings.
5. Indicate proposed locations for distributed system flexible fittings and/or connections.
6. Indicate locations of seismic separations where applicable.

E. Seismic Design Data:

1. Compile information on project-specific characteristics of actual installed HVAC components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
   a) Component operating weight and center of gravity.
   b) Component elevation in the building in relation to the roof elevation (z/h).
   c) Component importance factor (Ip).
   d) For distributed systems, component materials and connection methods.
   e) Component amplification factor (ap) and component response modification factor (Rp), determined in accordance with ASCE 7 tables.
   f) Applicability of overstrength factor (for certain anchorage in concrete and masonry).
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

F. Certification for seismically qualified equipment; identify basis for certification.

G. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

I. Evidence of qualifications for seismic controls designer.

J. Evidence of qualifications for manufacturer.

K. Manufacturer’s detailed field testing and inspection procedures.

L. Field quality control test reports.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with experience designing seismic restraints for nonstructural components.

1. Designer may be employed by the manufacturer of the seismic restraint products.

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:

1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.

D. Piping Isolation:

1. Provide vibration isolators for piping supports:
   a) Located in equipment rooms.
   b) Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
   c) For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.
2. Minimum Static Deflection:
   a) First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
   b) Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Suspended Piping, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.

6. Floor-Mounted Piping, Seismic Applications: Use seismic type restrained spring isolators.
7. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

E. Thrust Restraint Applications:

1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg or greater total static pressure.
2. Limit lateral movement to 0.25 inch or less unless otherwise indicated.

2.02 SEISMIC CONTROL REQUIREMENTS

A. Design and provide HVAC component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor HVAC components.

B. Seismic Design Criteria: As indicated on the drawings. If information is not available on the drawings, the contractor will use the ASCE Hazzard Tool to determine. https://ascehazardtool.org.

C. Component Importance Factor (Ip): HVAC components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to:

1. HVAC components required to function for life safety purposes after an earthquake.
2. HVAC components that support or otherwise contain hazardous substances.

D. Seismic Qualification of Equipment:

1. Provide special certification for HVAC equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.

3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

E. Premanufactured Modular HVAC Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.

F. Seismic Restraints:

1. Provide seismic restraints for HVAC components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
2. Seismic Restraint Exemptions:
   a) Exemptions for Seismic Design Category C:
      1) HVAC components where either of the following apply:
         (a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
         (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
      2) HVAC piping with component importance factor (Ip) of 1.5 and nominal pipe size of 2 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
   b) Duct System Exemptions, All Seismic Design Categories:
      1) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control with component importance factor (Ip) of 1.0, where flexible connections or other assemblies are provided between duct system and associated components, where duct system is positively attached to the structure, and where one of the following apply:
         (a) Trapeze supported duct with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
         (b) Trapeze supported duct with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to

the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.

(c) Trapeze supported duct with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.

(d) Hanger supported duct with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.

2) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control, where there are provisions to avoid impact with other ducts or mechanical components or to protect ducts in the event of such impact, and where duct system is positively attached to the structure and has a cross sectional area of less than 6 square feet and weighs 20 pounds per foot or less.

c) HVAC Piping Exemptions, All Seismic Design Categories:

1) HVAC piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:

(a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.

(b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.

(c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.

(d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category

exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.

(e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor (Ip) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.

3. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
4. Seismic Type Vibration Isolators:
   a) Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
5. External Seismic Snubber Assemblies:
   a) Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
   b) Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
6. Seismic Restraint Systems:
   a) Except where otherwise restricted, use of either cable or rigid restraints is permitted.
   b) Use only cable restraints to restrain vibration-isolated HVAC components, including distributed systems.
   c) Use only one restraint system type for a given HVAC component or distributed system (e.g., ductwork, piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
   d) Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain HVAC component in all lateral directions; consider bracket geometry in anchor load calculations.
   e) Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported HVAC component weight.
   f) Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported HVAC component weight.
   g) Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.

h) Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
i) Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

7. Ductwork Applications:
   a) Provide independent support and seismic restraint for in-line components (e.g., fans, heat exchangers, humidifiers) having an operating weight greater than 75 pounds.
   b) Positively attach appurtenances (e.g., dampers, louvers, diffusers) with mechanical fasteners.

G. Seismic Attachments:

1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
   a) Increase size of pad as required to comply with anchor requirements.
   b) Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

H. Seismic Interactions:

1. Include provisions to prevent seismic impact between HVAC components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.

I. Seismic Relative Displacement Provisions:

1. Use suitable fittings or flexible connections to accommodate:

a) Relative displacements at connections between components, including distributed systems (e.g., ductwork, piping); do not exceed load limits for equipment utility connections.
b) Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
c) Design displacements at seismic separations.
d) Anticipated drifts between floors.

2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:

1. Vibration-Isolated Equipment Support Bases:
2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Vibration-Isolated Structural Steel Bases:

1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.

C. Vibration-Isolated Concrete Inertia Bases:

1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Minimum Base Depth: 6 inches.
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 03 3000.
6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
7. Pump Applications: Size and configure bases for piping elbow supports as required.

2.04 VIBRATION ISOLATORS

A. Manufacturers:

1. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
    a) Color code or otherwise identify springs to indicate load capacity.
    b) Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
    c) Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
    d) Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
    e) Selected to provide designed deflection of not less than 75 percent of specified deflection.
    f) Selected to function without undue stress or overloading.
3. Seismic Snubbing Elements for Seismic Isolators:
    a) Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
    b) Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

C. Vibration Isolators for Nonseismic Applications:

1. Resilient Material Isolator Pads:
    a) Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
    b) Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
    c) Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Resilient Material Isolator Mounts, Nonseismic:
    a) Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
3. Open (Unhoused) Spring Isolators:
    a) Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
    b) Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
    c) Furnished with integral leveling device for positioning and securing supported equipment.
4. Housed Spring Isolators:
    a) Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.

b) Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
c) Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
d) Furnished with integral leveling device for positioning and securing supported equipment.

5. Restrained Spring Isolators, Nonseismic:
   a) Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
   b) Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c) Furnished with integral leveling device for positioning and securing supported equipment.
   d) Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Nonseismic:
   a) Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Nonseismic:
   a) Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b) Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
   a) Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
   b) Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
9. Thrust Restraints:
   a) Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

D. Vibration Isolators for Seismic Applications:

1. Resilient Material Isolator Mounts, Seismic:
    a) Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
2. Restrained Spring Isolators, Seismic:
    a) Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
    b) Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
    c) Furnished with integral leveling device for positioning and securing supported equipment.
    d) Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
    a) Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:
    a) Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
    b) Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
    a) Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
    b) Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A. Manufacturers:

1. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

C. Seismic Snubbing Elements:

1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.06 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:

1. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:

1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.

1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Seismic special inspections include, but are not limited to:

1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
3. Installation and anchorage of ductwork designed to carry hazardous materials for Seismic Design Categories C, D, E and F; periodic inspection.
4. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
5. Verification of required clearances between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

D. Vibration Isolation Systems:

1. Vibration-Isolated Equipment Support Bases:
    a) Provide specified minimum clearance beneath base.
2. Spring Isolators:
    a) Position equipment at operating height; provide temporary blocking as required.
    b) Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
    c) Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
3. Isolator Hangers:
    a) Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
    b) Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
4. Thrust Restraints:
    a) Adjust restraint movement under normal operating static pressure.
5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
7. Adjust isolators to be free of isolation short circuits during normal operation.
8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

E. Seismic Controls:

1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.

2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
4. Equipment with Sheet Metal Housings:
    a) Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
    b) Attach additional steel as approved by manufacturer where required to transfer loads to structure.
    c) Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
    a) Size in accordance with seismic design to meet anchor requirements.
    b) Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
    a) Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
    b) Install restraints within permissible angles in accordance with seismic design.
    c) Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
    d) Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
    e) Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

A. See Division 01 for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Vibration Isolation Systems:

1. Verify isolator static deflections.
2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

D. Seismic Controls:

1. Verify snubbing element air gaps.

E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 23 0548

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.03 SUBMITTALS

A. See Division 01 for additional requirements.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com

B. Brimar Industries, Inc: www.pipemarker.com

C. Craftmark Pipe Markers: www.craftmarkid.com

D. Seton Identification Products, a Tricor Direct Company: www.seton.com

E. Substitutions: See Section 016000-Product Requirements.

2.02 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Automatic Controls: Tags. Key to control schematic.

C. Control Panels: Nameplates.

D. Instrumentation: Tags.

E. Major Control Components: Nameplates.

F. Piping: Pipe markers.

G. Rooftop Units: Nameplates

H. Small-sized Equipment: Nameplates

2.03 NAMEPLATES

A. Letter Color: Black.

B. Background Color: White.

C. Minimum Size: 3" x 1"

D. Air Handling Units Minimum Size: 6" x 3"

E. Plastic: Comply with ASTM D709.

2.04 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

B. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.05 PIPE MARKERS

A. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

B. Plastic Arrow Banding Tape: Flexible, vinyl film tape with pressure sensitive adhesive backing.

1. Comply with ANSI / ASME A13.1 2020,

C. Color code as follows:

1. Heating Water, Chilled Water, and Condensing Water: Green with white letters.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions. Include directional arrow banding.

D. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 23 0553

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Measurement of final operating condition of HVAC systems.

1.02 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).

C. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems; 2026.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.03 SUBMITTALS

A. See Division 01 for additional requirements.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Include at least the following in the plan:
   a) List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
   b) Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
   c) Discussion of what notations and markings will be made on the duct and piping drawings during the process.
   d) Final test report forms to be used.
   e) Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
5. Units of Measure: Report data in I-P (inch-pound) units only.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC (NSTSB), AABC National Standards for Total System Balance.
2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available toEngineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

H. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

I. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

J. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.07 SCOPE

A. Test, adjust, and balance the following:

1. Air Coils.
2. Air Rotation Units.
3. Fans.
4. Air Inlets and Outlets.

3.08 MINIMUM DATA TO BE REPORTED

A. Cooling Coils:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Saturated suction temperature, design and actual.
11. Air pressure drop, design and actual.

B. Heating Coils:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Entering air temperature, design and actual.
7. Leaving air temperature, design and actual.
8. Air pressure drop, design and actual.

C. Air Moving Equipment:

1. Location.
2. Manufacturer.

3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

D. Return Air/Outside Air:

1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

E. Exhaust Fans:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

F. Air Distribution Tests:

1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Design air flow.
6. Test (final) air flow.
7. Percent of design air flow.

END OF SECTION 23 0593

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Outdoor weather-proof insulation.

C. Duct liner.

1.02 RELATED REQUIREMENTS

A. Section 23 3100 - HVAC Ducts and Casings

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

D. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.

E. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 MANUFACTURES

A. Johns Manville[<>]: www.jm.com

B. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com

C. Owens Corning Corporation[<>]: www.ocbuildingspec.com

D. Substitutions: See Division 01 for additional requirements.

2.03 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible blanket.

1. K value: 0.29 at 75 degrees F @ Labeled Thickness, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 250 degrees F.
3. Maximum Water Vapor Absorption: <5 percent by weight.

B. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

C. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.04 GLASS FIBER, RIGID

A. Insulation: ASTM C612; rigid, noncombustible blanket.

1. K Value: 0.23 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Water Vapor Absorption: <2.0 percent by weight at 120 degrees F, 95% RH.
4. Maximum Density: 3 lb/cu ft.

B. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.

2. Moisture Vapor Permeability: 0.04 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

C. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.05 OUTDOOR WEATHER-PROOF INSULATION

A. Weather-Proof Outdoor Cladding

1. Color: Polar white with reflective sheet.
2. Density: 6,350 psi tensile strength
3. Thermal Conductivity: K=0.146 BTU/in/ft2/hr./degree F
4. R-Value = 8.1
5. Temperature Limits: 165 degree F (exterior)
6. Vapor Barrier: Autohesively bonded aluminum foil with zero permeability 1000 micron UV stable vinyl.
7. Manufacturers:
   a) Thermanduct, LLC: www.thermaduct.com
   b) See Section 01 6000 - Product Requirements

2.06 DUCT LINER

A. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; rigid board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.

1. Fungal Resistance: No growth when tested according to ASTM G21.
2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
3. Service Temperature: Up to 250 degrees F.
4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.

B. Adhesive: Waterproof, fire-retardant type, ASTM C916.

C. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. External Duct Insulation Application: Glass Fiber, Flexible

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
6. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

D. Duct and Plenum Liner Application:

1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for air-flow. Increase duct size to allow for insulation thickness.

E. Exterior Applications: Install outdoor weather-proof insulation system in strict accordance with manufacturer’s instructions.

3.03 SCHEDULES

A. Supply Ducts: 2" Glass Fiber, Flexible

B. Return Ducts: 2" Glass Fiber, Flexible

C. Exhaust Ducts 2" Glass Fiber, Flexible

D. Transfer Ducts: 1" Glass Fiber, Flexible

E. Plenum Ducts: 1" Duct Liner, Rigid

F. Ducts Exposed to Outdoors: 2" Glass Fiber, Rigid Insulation covered with Outdoor Weather-Proof Insulation System.

END OF SECTION 23 0713

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

B. Section 23 2300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.

1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

2.03 JACKETS

A. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.

1. Thickness: 0.016 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated Pipes Conveying Fluids Below Ambient Temperature:

1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

F. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

A. Cooling Systems:

1. Condensate Drains from Cooling Coils (Inside): 3/4" Cellular Foam Insulation
2. Refrigerant Suction: 1" Flexible Elastomeric Cellular Insulation
3. Refrigerant Hot Gas: 1" Flexible Elastomeric Cellular Insulation

END OF SECTION 23 0719

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.02 REFERENCE STANDARDS

A. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2019.

B. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2019.

C. ANSI Z223.1 - National Fuel Gas Code; 2024.

D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

E. ASME B31.1 - Power Piping; 2018.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

H. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2019.

I. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2014.

J. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.

K. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.

L. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

1.03 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.06 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.

1. Fittings: ASTM A234/A234M, wrought steel welding type.
2. Joints: ANSI Z223.1, welded.
3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
4. Mechanical Press Sealed Fittings: Double pressed type and approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.
    a) Manufacturers:
        1) Apollo Valves: www.apollovalves.com
        2) Viega LLC; MegaPress: www.viega.us
        3) Or Approved Equal: See Division 01 for additional requirements.

B. Flexible Gas Piping:

1. Corrugated Stainless Steel Tubing: Comply with ANSI LC1 / CSA 6.26.
2. Fittings: Provided by piping system manufacturer.
3. Manufacturers:
   a) Omega Flex, Inc; TracPipe PS-II: www.omegaflex.com
   b) Or Approved Equal; See Division 01 for additional requirements.

2.02 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
2. Joints: Threaded or welded to ASME B31.1.
3. Mechanical Press Sealed Fittings: Double pressed type and approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.
   a) Manufacturers:
      1) Apollo Valves: www.apollovalves.com
      2) Viega LLC; MegaPress: www.viega.us
      3) Or Approved Equal; See Division 01 for additional requirements.

2.03 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:

1. Ferrous Pipe: Class 150 malleable iron threaded unions.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.04 BALL VALVES

A. Manufacturers:

1. Apollo Valves: www.apollovalves.com
2. Nibco, Inc: www.nibco.com
3. Viega LLC: www.viega.us
4. Or Approved Equal: See Division 01 for additional requirements.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze body, chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle, threaded ends with union.

2.05 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com
2. Green Country Filter Manufacturing: www.greencountryfilter.com
3. WEAMCO: www.weamco.com
4. Or Approved Equal: See Division 01 for additional requirements.

B. Size 2 inch and Under:

1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

2.06 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

A. Manufacturers:

1. Actaris Metering Systems (A brand of ITT Controls): www.actaris-metering-systems.com/#sle.
2. Maxitrol Company: www.maxitrol.com/#sle.
3. Sensus.
4. Or Approved Equal: See Division 01 for additional requirements.

B. Compliance Requirements:

1. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.

C. Materials in Contact With Gas:

1. Housing: Aluminum, steel (free of non-ferrous metals).
2. Seals and Diaphragms: NBR-based rubber.

D. Maximum Inlet Operating Pressure: 10 psi.

1. Line Pressure Regulator: 10 psi.

E. Maximum Body Pressure: 10 psi.

F. Output Pressure Range: 1 inch wc to 80 inch wc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

F. Provide access where valves and fittings are not exposed.

G. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.

H. Provide support for utility meters in accordance with requirements of utility companies.

I. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. **All exposed gas piping (interior and exterior) shall be painted yellow and properly labeled.**

J. Install valves with stems upright or horizontal, not inverted.

K. Sleeve pipes passing through partitions, walls and floors.

L. Pipe Hangers and Supports:

1. Support horizontal piping as indicated. Refer to Section 230529.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball valves for throttling, bypass, or manual flow control services.

D. Provide plug valves in natural gas systems for shut-off service.

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

1.02 RELATED REQUIREMENTS

A. Section 23 0713 - Duct Insulation: External insulation and duct liner.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.

C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide data for duct materials and duct connections.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.

B. Ducts: Galvanized steel, unless otherwise indicated.

C. Low Pressure Supply: 2 inch w.g. pressure class, galvanized steel.

D. Return and Relief: 2" inch w.g. pressure class, galvanized steel.

E. General Exhaust: 2" inch w.g. pressure class, galvanized steel.

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

F. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Rectangular Ductwork: Shall conform to SMACNA HVAC Duct Construction Standards, Metal and Flexible or SMACNA Rectangular Industrial Duct Construction Standards.

1. Cross-Breaking:
   a) Sheet metal ducts and fittings over 19" wide be beaded, cross-broken, or otherwise stiffened, to eliminate oil canning or vibration.
   b) Vertical and horizontal sheet metal barriers, duct offsets, and elbows 19" wide or larger shall be cross-broken.
   c) Cross-breaking shall be applied to the sheet metal between the standing seams or reinforcing angles. The center of cross-break shall be of the required height to assure surfaces being rigid.
2. Radius Elbows: Radius elbows with a rectangular cross section shall have a centerline radius of not less than the width of the duct or shall be furnished with single thickness splitter vanes. A single splitter vane shall be used for elbows with a ratio of inside radius to duct width of 0.5 to 0.2. Two splitter vanes shall be used for ratios less than 0.20.

3. Square Elbows: Square elbows shall be equipped with either single or double thickness turning vanes, with a radius of 4.5", and a separation of 3.25", pre-assembled on runners constructed per SMACNA Accepted Industry Practice for Industrial Duct Design. Vanes shall be securely attached to the runners. Vanes shall be welded to the runners in systems with pressures greater than 6" w.g. or velocities greater than 3000 FPM. The maximum unsupported length of vanes shall be 36".

B. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.

1. Manufacture in accordance with SMACNA (DCS).

C. Round Ducts: Round lockseam duct with galvanized steel outer wall.

1. Manufacture in accordance with SMACNA (DCS).

D. Acoustic Flexible Ducts: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.

1. Insulation: 2" Fiberglass insulation with reinforced vapor barrier.
2. Inner Core: Spun-bonded, non-woven inner core.
3. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative. (4"-12" ID)
4. Maximum Velocity: 5,000 fpm.']
5. Temperature Range: Minus 20 degrees F to 210 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Flexible Ducts: Connect to metal ducts with liquid adhesive plus tape.

E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

G. Connect diffusers plenum boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

H. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

3.02 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION 23 3100

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Inline centrifugal fans.

1.02 REFERENCE STANDARDS

A. AMCA 99 - Standards Handbook; 2025.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

A. Permanent ventilators may not be used for ventilation during construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carnes, a division of Carnes Company Inc: www.carnes.com

B. Greenheck Fan Corporation: www.greenheck.com

C. Loren Cook Company: www.lorencook.com

D. Or Approved Equal: See Division 01 for additional requirements.

2.02 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.

B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.

D. Fabrication: Comply with AMCA 99.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.03 INLINE CENTRIFUGAL FANS

A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

B. Disconnect Switch: Cord and plug in housing for thermal overload protected motor.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Hung Cabinet Fans:

1. Install flexible connections between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

C. Install backdraft dampers on inlet to roof and wall exhausters.

END OF SECTION 23 3423

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

C. Louvers.

1.02 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.

B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).

C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. American Louver Company: www.americanlouver.com

B. Carnes, a division of Carnes Company Inc: www.carnes.com

C. Metalaire, a brand of Metal Industries Inc: www.metalaire.com

D. Price Industries: www.price-hvac.com

E. Ruskin Company: www.ruskin.com

F. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com

G. Tuttle and Bailey: www.tuttleandbailey.com

H. Or Approved Equal: See Division 01 for additional requirements.

2.02 CEILING DIFFUSERS AND GRILLES

A. Refer to the schedules on the drawings.

2.03 LOUVERS

A. Type: 6 inch deep frame with drainable brades, heavy channel frame, 1/2 inch square mesh screen over intake or exhaust end.

B. Fabrication: 12 gage, 0.1046 inch (2.66 mm) thick extruded aluminum thick galvanized steel welded assembly, with factory prime coat finish.

C. Color: To be selected by Architect from manufacturer's full range.

D. Mounting: Furnish with interior flat flange for installation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

D. Install diffusers to ductwork with air tight connection.

E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

F. Paint ductwork visible behind air outlets and inlets matte black.

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured units.

B. Casing.

C. Condenser coils.

D. Fans and motors.

E. Controls.

1.02 RELATED REQUIREMENTS

A. Section 23 2300 - Refrigerant Piping.

1.03 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).

C. ASHRAE Std 20 - Methods of Laboratory Testing Remote Mechanical-Draft Air-Cooled Refrigerant Condensers; 2019.

D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Refer to Division 01 for more information.

B. Product Data: Provide rated capacities, weights, accessories, electrical requirements, and wiring diagrams.

C. Shop Drawings: Indicate components, assembly, dimensions, weights and loading, required clearances, and location and size of field connections. Include schematic layouts showing condenser, refrigeration compressors, cooling coils, refrigerant piping and accessories required for complete system.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

B. Protect units on site from physical damage. Protect coils.

1.07 WARRANTY

A. The manufacturer shall provide 12 month parts only warranty. Defective parts will be repaired or replaced during the warranty period at no charge. The warranty period shall commence at start up, or 6 months after shipment, whichever occurs first.

B. The manufacturer shall provide 5 year compressor warranty. Defective parts will be repaired or replaced during the warranty period at no charge. The warranty period shall commence at start up, or 6 months after shipment, whichever occurs first.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Daikin.

B. No substitions.

2.02 MANUFACTURED UNITS

A. Provide packaged, factory assembled, pre-wired unit, suitable for outdoor use consisting of casing, condensing coil and fans, integral sub-cooling coil liquid accumulator and controls.

B. Construction and Ratings: In accordance with AHRI 210/240 and UL 207. Testing shall be in accordance with ASHRAE Std 20.

C. Performance Ratings: Energy Efficient Rating (EER)/Coefficient of Performance (COP) not less than prescribed by ASHRAE Std 90.1 I-P, in combination with compressor units.

2.03 CABINET

A. Exterior surfaces shall be constructed of painted galvanized steel, for aesthetics and long-term durability. Paint finish will include a base primer with a high-quality polyester resin topcoat. Finished, unabraded panel surfaces shall be exposed to an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure. Finished, abraded surfaces shall be tested per ASTM D1654, having a mean scribe creepage not exceeding 1/16” at 1,000 hours minimum exposure to an ASTM B117 salt spray environment. Measurements of results shall be quantified using ASTM D1654 in conjunction with ASTM D610 and ASTM D714 to evaluate blister and rust ratings.

B. Access shall be provided to compressors and electrical and controls components.

C. The unit base frame shall be constructed of 13 gauge pre-painted steel to prevent base rail corrosion.

D. Lifting brackets shall be provided on the unit base with lifting holes to accept cable or chain hooks.

2.04 CONDENSING SECTION

A. Condenser fans shall be direct drive, axial type designed for low tip speed and vertical air discharge. Fan blades shall be constructed of steel and riveted to a steel center hub. Condenser fan motors shall be heavy-duty, inherently protected, three-phase, non-reversing type with permanently lubricated ball bearing and integral rain shield.

B. Condenser coils shall be an all aluminum design, and mounted on polymer brackets, to minimize di-electric corrosion. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. Each condenser coil shall be factory leak tested with high-pressure air under water.

C. Head Pressure Control

1. Units shall have at least one condenser fan controlled to maintain positive head pressure. SpeedTrol™ condenser fan speed control shall be added to the last fan off on each refrigeration circuit to provide cooling operation to ambient temperatures down to 0° F. Fan speed control shall be field adjustable.

D. Each unit shall have two independent refrigeration circuits for redundancy. Each circuit shall be complete with a low pressure control, filter-drier, liquid moisture indicator/sight-glass, thermal expansion valve, and a manual reset high pressure safety switch. The thermal expansion valve shall be capable of modulation from 100% to 25% of its rated capacity. Sight-glasses shall be accessible for viewing without disrupting unit operation. Each circuit shall be dehydrated and factory charged with Refrigerant R32 and oil.

E. Each unit shall have at least 4 compressor stages of cooling capacity control for better part load control as required by ASHRAE 90.1-2013.

2.05 CONTROLS

A. Each unit shall be equipped with a complete MicroTech® microprocessor based control system. The unit control system shall include all required temperature and pressure sensors, input/output boards, main microprocessor and operator interface. All boards shall be individually replaceable for ease of service. All microprocessors, boards, and sensors shall be factory mounted, wired and tested.

B. The microprocessor shall be a stand-alone DDC controller not dependent on communications with any on-site or remote PC or master control panel. The microprocessor shall maintain existing set points and operate standalone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures.

C. The main microprocessor shall support an RS-232 direct connection to a product service tool or a modem.

D. All digital inputs and outputs shall be protected against damage from transients or wrong voltages. Each digital input and digital output shall be equipped with an LED for ease of service. All field wiring shall be terminated at a separate, clearly marked terminal strip.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Align condensers on concrete foundations.

C. Provide connection to refrigeration piping system. Refer to Section 23 2300. Comply with ASHRAE Std 15.

D. Provide cooling season start-up, winter season shut-down service, for first year of operation.

E. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

END OF SECTION 23 6313

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged outdoor air handling unit.

B. Unit controls.

C. Maintenance service.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.

1.03 SUBMITTALS

A. Refer to Division 01 for additional information.

B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

C. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

D. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.06 WARRANTY

A. The manufacturer shall provide 12 month parts only warranty. Defective parts will be repaired or replaced during the warranty period at no charge. The warranty period shall commence at start up, or 6 months after shipment, whichever occurs first.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Johnson Air-Rotation; An Arizon Family of Brands.

2.02 MANUFACTURED UNITS

A. General: Ground mounted units having gas burner and electric refrigeration.

B. Description: Verical air handling unit, factory assembled and prewired, consisting of cabinet and frame, supply fan, heat exchanger and burner, controls, air filters, and DX refrigerant cooling coil.

2.03 FABRICATION

A. Cabinet: Steel with baked enamel finish, including access panels with screwdriver operated flush cam type fasteners. Structural members shall be minimum 18 gage, 0.0478 inch, with access doors or panels. ____

B. Heat Exchangers: Stainless steel, of welded construction.

C. Supply Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch motor pulley, and rubber isolated hinge mounted high efficiency motor or direct drive as indicated.Refer to Section 22 0548.

D. Air Filters:

1. 1 inch thick glass fiber disposable media in metal frames.

2.04 BURNER

A. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot.

B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.

2.05 EVAPORATOR COIL

A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.

B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

2.06 MIXED AIR CASING

A. Dampers: Provide manual outside and return air dampers for fixed outside air quantity.

B. Gaskets: Provide tight fitting dampers with edge gaskets maximum leakage 5 percent at 2 inches pressure differential.

2.07 OPERATING CONTROLS - SINGLE ZONE UNITS

A. Electric solid state microcomputer based room thermostat, located as indicated in service area with remote sensor located as indicated.

B. Room thermostat shall incorporate:

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Short cycle protection.
4. Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

C. Room thermostat display shall include:

1. Actual room temperature.
2. Programmed temperature.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete pad is ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.03 SYSTEM STARTUP

A. Prepare and start equipment. Adjust for proper operation.

3.04 MAINTENANCE

A. Provide service and maintenance of air handling unit for one year year from Date of Substantial Completion.

B. Provide routine maintenance service with a two month interval as maximum time period between calls.

C. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.

D. After each service call, submit copy of service call work order or report that includes description of work performed.

END OF SECTION 23 7413

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air-source heat pumps.

B. Indoor air handling (fan and coil) units for ductless systems.

C. Controls.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.

B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).

D. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

G. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Division 01 for additional requirements.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 WARRANTY

A. See Division 01 for additional requirements.

B. Provide five year manufacturers warranty for compressors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Daikin

B. Or Approved Equal: See Division 01 for additional requirements.

2.02 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.

1. Cabinet: Galvanized steel.
   a) Finish: White.
2. Fan: Line-flow fan direct driven by a single motor.
3. Filter return air with washable, antioxidant pre-filter and a pleated anti-allergy enzyme filter.

B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.

2.03 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

1. Comply with AHRI 210/240.
2. Refrigerant: R-32.
3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.

B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.

C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

1. Condenser Fans: Direct-drive propeller type.

D. Coil: Air-cooled, aluminum fins bonded to copper tubes.

E. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).

1. Provide thermostatic expansion valves.
2. Provide heat pump reversing valves (for heat pump units).

F. Operating Controls:

1. Control by room thermostat to maintain room temperature setting.

2.04 ACCESSORY EQUIPMENT

A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from setpoint.
3. Thermostat Display:
   a) Time of day.
   b) Actual room temperature.
   c) Programmed temperature.
   d) System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with NFPA 90A and NFPA 90B.

C. Install refrigeration systems in accordance with ASHRAE Std 15 and manufacturer's recommendations. Sleeve and seal all pipe penetrations into building.

D. Pipe drain from cooling coils as shown on the drawings. If no route is shown, the contractor shall propose one going to the nearest floor drain (where allowed) or to the exterior.

E. Mount condensing units on 4" concrete housekeeping pad, unless otherwise shown on the drawings.

END OF SECTION 23 8126.13

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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. Section includes supplementary general requirements for the following:

1. Codes and Standards
2. Conflicting Requirements
3. Specifications and Drawing Conventions
4. Coordination with Occupants
5. Fees, Permits, and Inspection
6. Submittals
7. Products
8. Warranties
9. Electrical License Requirement
10. Operation and Maintenance Manuals
11. Demolition, Salvage, and Waste
12. General Coordination for Electrical Work
13. Cutting and Patching
14. Painting
15. Continuity Tests
16. Connection Torque Tests
17. Mechanical Operation Tests
18. Rotational Tests

1.03 CODES, STANDARDS, AND REFERENCES

A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.

B. The **latest applicable edition** of specifications and standards of issues listed below but referred to thereafter by basic designation only, form a part of these specifications:

1. National Electrical Code
2. National Fire Protection Association's Recommended Practices
3. Local, City & State Codes & Ordinances
   National Electrical Safety Code
4. Underwriter's Laboratories, Inc.
5. Illumination Engineering Society
6. Institute of Electrical & Electronic Engineers
7. Insulated Power Cable Engineers Association
8. National Electrical Manufacturers Association
9. Earthquake Requirement of the International Building Code
10. American Society for Testing Materials
11. Occupational Safety & Health Act
12. Service requirements of serving utility company
13. Americans with Disabilities Act (ADA)
14. ASHRAE / IESNA Standard 90.1
15. Arkansas Energy Code

1.04 CONFLICTING REQUIREMENTS

A. Conflicting requirements: If compliance with standards, codes, regulations, and specifications establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

1.05 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. 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. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.06 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.07 WORK RESTRICTIONS

A. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than 7 days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

1.08 FEES, PERMITS, AND INSPECTIONS

A. This Contractor shall be responsible for all costs incurred by any serving utility, municipal authority, and/or Owner for the relocation, removal, and installation of temporary or new services.

B. The Contractor shall be responsible for coordinating and providing the exact service equipment and installation methods with the serving utility, municipal authority, and/or Owner prior to bidding. Failure to do so will not constitute sufficient grounds for an authorized change order to the project.

1.09 PROJECT / SITE CONDITIONS:

A. Install Work in locations shown on Drawings, unless prevented by Project conditions. The Architect / Owner reserves the right to relocate any device a maximum distance of 6' - 0" at the time of installation without an extra cost being incurred.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect / Engineer before proceeding.

1.10 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. The Contractor shall submit five (5) copies to the Architect for approval, a list of all equipment he proposes to furnish, together with descriptive literature, capacities, manufacturer's name, approximately delivery date and any other pertinent facts concerning the various items. The submittal shall consist of a tabulation of all items included, followed by catalog and data sheets, wiring diagrams, etc., all bound in one folder, loose leaf sheets will not be acceptable.
2. The equipment listed herein or on the drawings will be furnished as specified unless scheduled "or equal". If "or equal" is indicated, the product of any reputable manufacturer regularly engaged in the commercial production of the

specified equipment will not be excluded on the basis of minor differences, provided all essential requirements of this specification relative to materials, limitations of available space for equipment, capacity, and performance are met. The Contractor shall be responsible for any and all additional costs required by modifications to architectural, structural, mechanical or electrical facilities, devices, systems, etc. resulting from the approved substitution.

3. Wherever the substituted equipment actually furnished under these specifications requires the use of larger connections, more connections, or a different connection arrangement than indicated on the drawings or specified under these specifications, the Contractor shall furnish a scaled drawing showing how he proposes to install substituted equipment. Drawings shall show clearances and be coordinated with other mechanical and electrical equipment in the space. Should a substitution require the Architect or Engineer to provide additional services to accommodate it, the Contractor shall be responsible for costs incurred by the Architect or Engineer.
4. All equipment having motors 1-1/2 horsepower and larger shall include have as part of the submittal package, a written description of the motor, manufacturer, model number and motor efficiency at full load. Failure to include motor data in the equipment submittal shall result in the automatic rejection of the submittal.
5. The Contractor shall submit shop drawings to the Architect in accordance with the schedule prepared by the General Contractor but not later than 45 calendar days after the date of the agreement. Failure to submit shop drawings within 45 days, shall disqualify the Contractor from substituting specified equipment.
6. The contractor shall not install any equipment or materials until the shop drawings for the equipment or materials have been approved.
7. The Contractor shall submit five (5) copies to the Architect for approval, a list of all equipment he proposes to furnish, together with descriptive literature, capacities, manufacturer's name, approximately delivery date and any other pertinent facts concerning the various items. The submittal shall consist of a tabulation of all items included, followed by catalog and data sheets, wiring diagrams, etc., all bound in one folder, loose leaf sheets will not be acceptable.
8. The equipment listed herein or on the drawings will be furnished as specified unless scheduled "or equal". If "or equal" is indicated, the product of any reputable manufacturer regularly engaged in the commercial production of the specified equipment will not be excluded on the basis of minor differences, provided all essential requirements of this specification relative to materials, limitations of available space for equipment, capacity, and performance are met. The Contractor shall be responsible for any and all additional costs required by modifications to architectural, structural, mechanical or electrical facilities, devices, systems, etc. resulting from the approved substitution.

9. Wherever the substituted equipment actually furnished under these specifications requires the use of larger connections, more connections, or a different connection arrangement than indicated on the drawings or specified under these specifications, the Contractor shall furnish a scaled drawing showing how he proposes to install substituted equipment. Drawings shall show clearances and be coordinated with other mechanical and electrical equipment in the space. Should a substitution require the Architect or Engineer to provide additional services to accommodate it, the Contractor shall be responsible for costs incurred by the Architect or Engineer.
10. All equipment having motors 1-1/2 horsepower and larger shall include have as part of the submittal package, a written description of the motor, manufacturer, model number and motor efficiency at full load. Failure to include motor data in the equipment submittal shall result in the automatic rejection of the submittal.
11. The Contractor shall submit shop drawings to the Architect in accordance with the schedule prepared by the General Contractor but not later than 45 calendar days after the date of the agreement. Failure to submit shop drawings within 45 days, shall disqualify the Contractor from substituting specified equipment.
12. The contractor shall not install any equipment or materials until the shop drawings for the equipment or materials have been approved.
13. Engineer will return annotated file.

B. Digital Data Files:

1. Electronic digital data files of the Project drawings may be provided by Engineer for Contractor's use in preparing submittals.
2. Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer’s Release Form. A signed release form and any payment required must be returned to the Engineer prior to the transmission of an electronic digital data files.
3. Electronic digital data file formats may include AutoCAD drawings, Revit converted to AutoCAD drawings or Revit Model.

C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer'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 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 14 days for review of each resubmittal.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Name file with submittal number or other unique identifier, including revision identifier.
2. Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
   a) Project name.
   b) Name and address of Engineer.
   c) Name of Construction Manager.
   d) Name of Contractor.
   e) Name of firm or entity that prepared submittal.
   f) Names of subcontractor, manufacturer, and supplier.
   g) Category and type of submittal.
   h) Specification Section number and title.
   i) Indication of full or partial submittal.
   j) Remarks.

F. Options: Identify options requiring selection by Engineer.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of revision in label or title block and clearly indicate extent of revision.
2. Resubmit submittals until they are marked with approval notation from Engineer.

1.11 CLOSEOUT SUBMITTALS

A. Closeout submittals shall include, but not limited to, the following:

1. Operation and Maintenance Materials
2. Record Drawings
3. Demonstration and Training Materials

1.12 QUALITY ASSURANCE

A. Products:

1. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
    a) Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
    b) If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.13 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.14 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Submit warranties in accordance with "Closeout Procedures."

1.15 FIELD CONDITIONS

A. The Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

1.16 GUARANTEE/WARRANTY

A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.

B. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the electrical systems under guarantees outlined above for a period of 1 full year after

acceptance by the Engineer and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for 1 full year after final acceptance by the Engineer.

1.17 ELECTRICAL LICENSE REQUIREMENT

A. No person shall perform electrical work on the contract without possessing a Master's or Journeyman's License from the State Electrical Examiners Board. All electrical work and apprentice electricians shall be supervised by a Master or Journeyman Electrician on a one to one ratio.

B. All electricians shall have a copy of their license with them and shall be required to show it to an appropriate inspector upon request.

PART 1 PRODUCTS

2.01 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals to Engineer.
    a) Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. Mark each copy of each submittal to show which products and options are applicable.
2. 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.

3. For equipment, include the following in addition to the above, as applicable:
   a) Wiring diagrams showing factory-installed wiring.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale and sufficiently large to show all pertinent features of the item, method of connections, and notations clearly legible. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.

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.

2.02 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.

2.03 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Where two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Products containing asbestos shall not be used.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
   a) Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
4. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer" or similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.04 COMPARABLE PRODUCTS

A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following

conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections.

2.05 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. After approval of materials and equipment for use in this project, a copy of an Operation and Maintenance Manual shall be submitted for approval.

B. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of equipment.
3. Table of contents.

C. 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.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Upon final approval, submit one (1) bound copy of the approved Operation and Maintenance Manual to the Architect and hold two (2) copies for instruction of Owner as hereinafter specified.

2.06 REQUIREMENTS FOR EMERGENCY, 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: Enable bookmarking of 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.

2.07 EQUIPMENT AND MATERIALS:

A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. The equipment to be furnished under each section of the specification shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design.

B. When 2 or more units of materials or equipment of the same type or class are required, these units shall be products of 1 manufacturer. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform

appearance, operation and maintenance. Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.

C. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

D. Asbestos products or equipment or materials containing asbestos shall not be used.

E. Equipment and materials shall be delivered to the site and stored in the original containers, suitably sheltered from the elements. Items subject to moisture damage (such as controls) shall be stored in dry, heated spaces.

F. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly. Damage or defects developing before acceptance of the work shall be made good at the Contractor’s expense.

G. It shall be the responsibility of the Contractor to insure that items to be furnished fit the space available. The Contractor shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the Drawings and Specifications.

H. Manufacturer’s directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. Should the Contractor perform any work that does not comply with the manufacturer’s directions, he shall bear all costs arising in correcting the deficiencies.

2.08 EQUIPMENT ACCESSORIES:

A. The Contractor shall furnish and install all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner, whether or not specifically shown on the plans or herein specified.

B. Connections: All final connections to equipment shall be installed as required by the manufacturer and/or Vendor.

C. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes. The Contractor shall provide any additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

PART 1 - EXECUTION

3.01 CONTRACTOR'S SUBMITTAL REVIEW

A. Action 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 Engineer.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.02 ENGINEER'S SUBMITTAL ACTION

A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it.

B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

D. Submittals not required by the Contract Documents may be returned by the Engineer without action.

3.03 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Disposal: Remove waste materials from Owner's property and legally dispose of them

3.04 RECORD DRAWING RECORDING AND MAINTENANCE

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.

3.05 COORDINATION OF WORK

A. The Contractor shall compare the Electrical Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the Electrical Work. The Electrical Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.

B. Anchor bolts, sleeves, inserts and supports that may be required for the Electrical Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.

C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.

D. Locations of conduits, equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe and duct prior to fabrication.

1. Installation and Arrangement: The Contractor shall install all Electrical Work to permit removal (without damage to other parts) of coils, heat exchanger bundles, belt guards, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.
2. Access: The Contractor shall provide all necessary access panels in walls, ceilings, equipment, etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.

E. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in conduit, back box, device locations, etc. The Contractor shall provide any additional conduit, fittings, and other additional equipment required for the proper operation of the system resulting from the selection

of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

F. Connections: All conduit connecting to equipment shall be installed without strain at the conduit connection

G. Inaccessible Equipment

1. Where the Engineer or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

H. Electrical Coordination

1. Power: All power and motor wiring shall be performed under Division 26 unless otherwise noted for specific items. Control and interlock wiring shall be done by the Contractor of this Division.
2. Starters and Drives: All motor starters and drives unless included in other sections of the specifications shall be by Division 26. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.
3. Disconnects: All equipment furnished under this Division required to have a means of disconnect shall be supplied with a disconnect or a disconnect shall be furnished and installed by Division 26.

I. Dedicated Electrical Space: The space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone. The area above the dedicated space shall be

permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks or breaks in foreign systems. Every effort shall be made to eliminate foreign systems above equipment to the structural ceiling. If this is not possible, the Contractor shall encase any pipe in a second pipe with a minimum number of joints.

J. Lubrication: The Contractor shall be held responsible for all damage to bearings while the equipment is being operated up to the date of acceptance of the equipment. The Contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. Fan shafts, pump shafts, motor shafts, etc. shall be coated to prevent deterioration in moist or wet atmospheres.

3.06 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Under each section of the specifications, the Contractor shall be responsible for all required cutting, etc., incident to his work under that section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any major structural element, beam or column.
2. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades because of fault, error or tardiness or because of any damage done by own workmanship.
3. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements the "Occupant Coordination" article.

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    a) Clean piping, conduit, and similar features before applying paint or other finishing materials.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance.

Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.07 PAINTING

A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications. Equipment specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.

B. Apply paint to exposed piping according to the following, unless otherwise indicated:

1. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
2. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound. Any equipment scratched, marred or damaged will be repainted to the original condition.

3.08 CONTINUITY TEST:

A. The Contractor shall perform a continuity test on the affected portion of the electrical system prior to energizing the system to insure proper cable connections.

3.09 CONNECTION TORQUE TESTS:

A. All larger conductor bolted connections shall be torque tested using a torque wrench. Torque shall be to National Electrical Testing Association's (NETA) Standards.

3.10 MECHANICAL OPERATION TESTS:

A. All electrical equipment, such as switches, circuit breakers, etc., shall be tested by operating the device to verify that the mechanical portions of the device are functioning.

3.11 ROTATIONAL TESTS:

A. The Contractor shall assist all other trades in performing rotational tests on all motors provided under this contract. If rotational tests determine that conductors must be transposed to change direction of rotation, the conductors shall be changed at the make-up box on the motor; or if the change is made elsewhere, then the conductor's color coding shall be changed.

END OF SECTION 26 0000

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Underground feeder and branch-circuit cable.

C. Metal-clad cable.

D. Wiring connectors.

E. Electrical tape.

F. Heat shrink tubing.

G. Oxide inhibiting compound.

H. Wire pulling lubricant.

I. Cable ties.

J. Firestop sleeves.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2024.

F. IEEE 1210 - IEEE Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable; 2004 (Corrigendum 2014).

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.

I. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

M. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.

N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

Q. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.

R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

S. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

B. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 - PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

1. Exceptions:
    a) Use power and control tray cable or metal-clad cable for installation in cable tray.

C. Nonmetallic-sheathed cable is not permitted.

D. Armored cable is not permitted.

E. Metal-clad cable is permitted only as follows:

1. Where not otherwise restricted, may be used:
    a) Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
        1) Maximum Length: 6 feet.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

H. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

I. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

J. Conductor Material:

1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.

K. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.
    a) Exceptions:
        1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
        2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
        3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.

L. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

M. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
   a) Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
   a) 480Y/277 V, 3 Phase, 4 Wire System:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral/Grounded: Gray.
   b) 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral/Grounded: White.
   c) Equipment Ground, All Systems: Green.
   d) Travelers for 3-Way and 4-Way Switching: Pink.
   e) For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
   f) For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:
   a) Encore Wire Corporation
   b) General Cable Technologies Corporation
   c) Southwire Company
   d) Advance Wire and Cable, Inc

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits:
   a) Size 10 AWG and Smaller: Solid.
   b) Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
   a) Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.04 METAL-CLAD CABLE

A. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

B. Conductor Stranding:

1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

E. Grounding: Full-size integral equipment grounding conductor.

F. Armor: Steel, interlocked tape.

2.05 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Wiring Connectors for Splices and Taps:

1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors, mechanical connectors, or compression connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

C. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.

2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

1. Manufacturers:
   a) 3M
   b) Ideal Industries, Inc
   c) NSI Industries LLC

G. Mechanical Connectors: Provide bolted type or set-screw type.

1. Manufacturers:
   a) Burndy LLC
   b) Ilsco
   c) Thomas & Betts Corporation

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

1. Manufacturers:
   a) Burndy LLC
   b) Ilsco
   c) Thomas & Betts Corporation

2.06 ACCESSORIES

A. Electrical Tape:

1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
3. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

D. Wire Pulling Lubricant:

1. Manufacturers:
   a) 3M:
   b) American Polywater Corporation
   c) Ideal Industries, Inc
2. Listed and labeled as complying with UL 267.
3. Suitable for use with conductors/cables and associated insulation/jackets to be installed, when tested in accordance with IEEE 1210; approved by conductor/cable manufacturer.
4. Suitable for use at installation temperature.

E. Cable Ties: Material and tensile strength rating suitable for application.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

1. Products:
   a) HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.

a) Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
b) Increase size of conductors as required to account for ampacity derating.
c) Size raceways, boxes, etc. to accommodate conductors.

7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
8. Provide oversized neutral/grounded conductors where indicated and as specified below.
   a) Provide 200 percent rated neutral for feeders fed from K-rated transformers.
   b) Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

G. Terminate cables using suitable fittings.

1. Metal-Clad Cable (Type MC):
   a) Use listed fittings.
   b) Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

H. Install conductors with a minimum of 12 inches of slack at each outlet.

I. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

L. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

N. Insulate ends of spare conductors using vinyl insulating electrical tape.

O. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials.

Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

END OF SECTION 26 0519

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.
2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Field quality control test reports.

D. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. ANSI/IEEE Compliance: Comply with C114.1 (IEEE Std 142) and IEEE Stds Nos. 241 and 242 pertaining to grounding and ground-fault protection of power systems.

E. ANSI/UL Compliance: Comply with requirements of ANSI/UL and UL standards pertaining to grounding and ground-fault protection equipment and devices. Provide products which have been UL-listed and labeled.

F. NEMA Compliance: Comply with NEMA Stds Pub Nos. PB 1.2 and AB 1, pertaining to construction and installation of ground-fault protection devices and molded-case circuit breakers.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
   a) Provide continuous grounding electrode conductors without splice or joint.
   b) Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
2. Metal Underground Water Pipe(s):
   a) Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
   b) Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
   c) Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
3. Metal In-Ground Support Structure:
   a) Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
4. Concrete-Encased Electrode:
   a) Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

G. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
8. Provide bonding for metal building frame.

H. Pole-Mounted Luminaires: Also comply with Section 26 5600.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:

1. Use insulated copper conductors unless otherwise indicated.
   a) Exceptions:
      1) Use bare copper conductors where installed underground in direct contact with earth.
      2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
4. Manufacturers - Mechanical and Compression Connectors:
   a) Advanced Lightning Technology (ALT)
   b) Burndy LLC
   c) Harger Lightning & Grounding
   d) Thomas & Betts Corporation
5. Manufacturers - Exothermic Welded Connections:
   a) Burndy LLC
   b) thermOweld, subsidiary of Continental Industries; division of Burndy LLC

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.

D. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 0553.

F. Neutrals of lighting systems shall be grounded independently and in accordance with the National Electrical Code.

G. All metal raceway system, including cabinets, conduit and boxes, shall be grounded to a water pipe with UL approved grounding clamp in accordance with the National Electrical Code.

H. An equipment ground conductor shall be installed in all conduits.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.13.

C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 0526

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

D. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

E. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
2. Coordinate work to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 3000.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

1.06 QUALITY ASSURANCE

A. Maintain at project site one copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
   a) NFPA 70.
   b) Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
   a) Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
   b) Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
   c) Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
   d) Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

1. Manufacturers:

a) HoldRite, a brand of Reliance Worldwide Corporation

D. Metal Channel/Strut Framing Systems:

1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Comply with MFMA-4.
3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
4. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:
   a) Equipment Supports: 1/2-inch diameter.
   b) Busway Supports: 1/2-inch diameter.
   c) Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
   d) Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
   e) Trapeze Support for Multiple Conduits: 3/8-inch diameter.
   f) Outlet Boxes: 1/4-inch diameter.
   g) Luminaires: 1/4-inch diameter.

F. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Stud Walls: Use toggle bolts.
5. Steel: Use beam clamps, machine bolts, or welded threaded studs.
6. Sheet Metal: Use sheet metal screws.
7. Wood: Use wood screws.
8. Plastic and lead anchors are not permitted.
9. Powder-actuated fasteners are not permitted.
10. Hammer-driven anchors and fasteners are not permitted.
11. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a) Manufacturer: Same as manufacturer of metal channel/strut framing system.
    b) Comply with MFMA-4.
    c) Channel Material: Use galvanized steel.
    d) Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Field Welding, Where Approved by Architect: See Section 05 5000.

H. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

J. Secure fasteners in accordance with manufacturer's recommended torque settings.

K. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 0529

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Stainless steel rigid metal conduit (RMC).

C. Aluminum rigid metal conduit (RMC).

D. Galvanized steel intermediate metal conduit (IMC).

E. Stainless steel intermediate metal conduit (IMC).

F. PVC-coated galvanized steel rigid metal conduit (RMC).

G. Flexible metal conduit (FMC).

H. Liquidtight flexible metal conduit (LFMC).

I. Galvanized steel electrical metallic tubing (EMT).

J. Stainless steel electrical metallic tubing (EMT).

K. Aluminum electrical metallic tubing (EMT).

L. Rigid polyvinyl chloride (PVC) conduit.

M. Liquidtight flexible nonmetallic conduit (LFNC).

N. Reinforced thermosetting resin conduit (RTRC).

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete encasement of conduits.

B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Cable assemblies consisting of conductors protected by integral metal armor.

C. Section 26 0526 - Grounding and Bonding for Electrical Systems.

1. Includes additional requirements for fittings for grounding and bonding.

D. Section 26 0529 - Hangers and Supports for Electrical Systems.

E. Section 26 0533.16 - Boxes for Electrical Systems.

F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.

F. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; 2004.

G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2025.

H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.

J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.

K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.

L. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.

M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

O. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

P. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

Q. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.

R. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

S. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

T. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

U. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

V. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.

W. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

X. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

Y. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

Z. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

AA. UL 2420 - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

B. Shop Drawings:

1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
2. Include proposed locations of roof penetrations and proposed methods for sealing.

C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

A. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:

1. Under Slab on Grade: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized

steel rigid metal conduit, galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).

3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.
5. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, stainless steel rigid metal conduit (RMC) elbows, galvanized steel intermediate metal conduit (IMC) elbows, stainless steel intermediate metal conduit (IMC) elbows, PVC-coated galvanized steel rigid metal conduit (RMC) elbows, or concrete-encased PVC elbows for bends.
6. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
7. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.

D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

1. Locations subject to physical damage include, but are not limited to:
   a) Where exposed below 8 feet, except within electrical and communication rooms or closets.
   b) Where exposed below 20 feet in warehouse areas.

J. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or stainless steel intermediate metal conduit (IMC).

1. Locations subject to severe physical damage include, but are not limited to:

K. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

M. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).

1. Maximum Length: 6 feet.

N. Flexible Connections to Vibrating Equipment:

1. Dry Locations: Use flexible metal conduit (FMC).
2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
3. Maximum Length: 6 feet unless otherwise indicated.
4. Vibrating equipment includes, but is not limited to:
   a) Transformers.
   b) Motors.

2.02 CONDUIT - GENERAL REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.

B. Electrical Service Conduits: See Section 26 2100 for additional requirements.

C. Fittings for Grounding and Bonding: See Section 26 0526 for additional requirements.

D. Provide conduit, fittings, supports, and accessories required for complete raceway system.

E. Provide products listed, classified, and labeled as suitable for purpose intended.

F. Minimum Conduit Size, Unless Otherwise Indicated:

1. Branch Circuits: 3/4 inch (21 mm) trade size.
2. Branch Circuit Homeruns: 3/4-inch trade size.
3. Control Circuits: 1/2 inch (16 mm) trade size.
4. Underground, Interior: 3/4-inch trade size.
5. Underground, Exterior: 1-inch trade size.

G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. Allied Tube & Conduit
2. Republic Conduit
3. Wheatland Tube, a Division of Zekelman Industries

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:

1. Manufacturers:
   a) Bridgeport Fittings Inc
   b) O-Z/Gedney, a brand of Emerson Electric Co
2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.

3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
4. Material: Use steel or malleable iron.
    a) Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
2. Material: Use stainless steel with corrosion resistance equivalent to conduit.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.05 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:

1. Allied Tube & Conduit
2. Republic Conduit
3. Wheatland Tube, a Division of Zekelman Industries

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:

1. Manufacturers:
    a) Bridgeport Fittings Inc
    b) O-Z/Gedney, a brand of Emerson Electric Co
2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
3. Material: Use steel or malleable iron.
    a) Do not use die cast zinc fittings.
4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.06 STAINLESS STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

2.07 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. Robroy Industries

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.

D. PVC-Coated Boxes and Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
4. Material: Use steel or malleable iron.
5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.

E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.08 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:

1. AFC Cable Systems, Inc
2. Electri-Flex Company
3. International Metal Hose

B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

C. Fittings:

1. Manufacturers:
   a) Bridgeport Fittings Inc
   b) O-Z/Gedney, a brand of Emerson Electric Co
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
   a) Do not use die cast zinc fittings.

2.09 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:

1. AFC Cable Systems, Inc
2. Electri-Flex Company
3. International Metal Hose

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:

1. Manufacturers:
   a) Bridgeport Fittings Inc
   b) O-Z/Gedney, a brand of Emerson Electric Co
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
   a) Do not use die cast zinc fittings.

2.10 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied Tube & Conduit
2. Republic Conduit
3. Wheatland Tube, a Division of Zekelman Industries

B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:

1. Manufacturers:
   a) Bridgeport Fittings Inc
   b) O-Z/Gedney, a brand of Emerson Electric Co
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
   a) Do not use die cast zinc fittings.
4. Embedded Within Concrete, Where Permitted: Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.11 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Connectors and Couplings: Use compression/gland or set-screw type.

2.12 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:

1. Cantex Inc
2. JM Eagle

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.

2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.13 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Manufacturers:

1. AFC Cable Systems, Inc
2. Electri-Flex Company
3. International Metal Hose

B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

C. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for type of conduit to be connected.

2.14 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

A. Manufacturers:

1. Champion Fiberglass, Inc
2. FRE Composites
3. United Fiberglass of America, Inc

B. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).

C. Supports: As recommended by manufacturer.

D. Fittings: Same type and manufacturer as conduit to be connected.

1. Cement-Tight Joints: Use bonded coupling or bell and spigot.
2. Cement-Tight and Watertight Joints: Use adhesive and manufacturer's standard gaskets.

2.15 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

E. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

F. Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.

G. Sealing Systems for Concrete Penetrations:

1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.

H. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

1. Products:
   a) Menzies Metal Products; Electrical Roof Stack and Cap
   b) Menzies Metal Products; Electrical Retro Box

I. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

1. Products:
   a) Quickflash Weatherproofing Products, Inc

J. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

1. Products:

a) HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.

K. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.

1. Products:
   a) Advance Products & Systems, LLC; Duct Bank Spacers

L. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for casing and conduit/duct arrangement to be installed.

1. Products:
   a) Advance Products & Systems, LLC; Bore Spacers

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.

D. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.

E. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.

F. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.

G. Liquidtight Flexible Nonmetallic Conduit (LFNC): Install in accordance with NECA 111.

H. Conduit Routing:

1. Unless dimensioned, conduit routing indicated is diagrammatic.
2. When conduit destination is indicated without specific routing, determine exact routing required.
3. Conceal conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
   a) Electrical rooms.
   b) Mechanical equipment rooms.
   c) Within joists in areas with no ceiling.
5. Unless otherwise approved, do not route exposed conduits:
   a) Across floors.
   b) Across roofs.
   c) Across top of parapet walls.
   d) Across building exterior surfaces.
6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
   a) Heaters.
   b) Hot water piping.
   c) Flues.
14. Group parallel conduits in same area on common rack.

I. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
    a) Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

J. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
8. Secure joints and connections to provide mechanical strength and electrical continuity.

K. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
8. Install firestopping to preserve fire resistance rating of partitions and other elements.

L. Underground Installation:

1. Minimum Cover, Unless Otherwise Indicated or Required:
   a) Underground, Exterior: 18 inches.
   b) Under Slab on Grade: 12 inches to bottom of slab.
2. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 26 0553.

M. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches on all sides unless otherwise indicated.

N. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.

3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
4. Where conduits are subject to earth movement by settlement or frost.

O. Conduit Sealing:

1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
   a) Where conduits pass from outdoors into conditioned interior spaces.
   b) Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

P. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

Q. Provide grounding and bonding; see Section 26 0526.

R. Identify conduits; see Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 0533.13

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Floor marking tape.

G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 09 9113 - Exterior Painting.

B. Section 09 9123 - Interior Painting.

C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

D. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.

E. Section 26 2300 - Low-Voltage Switchgear: Factory-installed mimic bus.

F. Section 26 2726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

G. Section 27 1000 - Structured Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

C. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:

1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 - PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    a) Switchgear:
        1) Identify ampere rating.
        2) Identify voltage and phase.
        3) Identify power source and circuit number. Include location when not within sight of equipment.
        4) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
    b) Switchboards:
        1) Identify ampere rating.
        2) Identify voltage and phase.
        3) Identify power source and circuit number. Include location when not within sight of equipment.
        4) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
    c) Panelboards:
        1) Identify ampere rating.
        2) Identify voltage and phase.
        3) Identify power source and circuit number. Include location when not within sight of equipment.
        4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
        5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
        6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
    d) Transformers:
        1) Identify kVA rating.
        2) Identify voltage and phase for primary and secondary.
        3) Identify power source and circuit number. Include location when not within sight of equipment.
        4) Identify load(s) served. Include location when not within sight of equipment.
    e) Enclosed switches, circuit breakers, and motor controllers:
        1) Identify voltage and phase.
        2) Identify power source and circuit number. Include location when not within sight of equipment.

3) Identify load(s) served. Include location when not within sight of equipment.

2. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
3. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
   a) Service equipment.
   b) Industrial control panels.
   c) Motor control centers.
   d) Elevator control panels.
   e) Industrial machinery.
4. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
   a) Minimum Size: 3.5 by 5 inches.
   b) Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
   c) Service Equipment: Include the following information in accordance with NFPA 70.
      1) Nominal system voltage.
      2) Available fault current.
      3) Clearing time of service overcurrent protective device(s).
      4) Date label applied.

B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
2. Identification for Communications Conductors and Cables: Comply with Section 27 1000.
3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:

5. Use underground warning tape to identify direct buried cables.

C. Identification for Raceways:

1. Use voltage markers, color-coded bands, or factory-painted conduits to identify systems other than normal power system for accessible conduits.
   a) Maximum Intervals: 20 feet.
   b) Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
      1) Field-Painting: Comply with Section 09 9123 and 09 9113.
      2) Vinyl Color Coding Electrical Tape: Comply with Section 26 0519.
   c) Color Code:
      1) Fire Alarm System: Red.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Manufacturers:
   a) Brimar Industries, Inc:
   b) Kolbi Pipe Marker Co
   c) Seton Identification Products
2. Materials:
   a) Indoor Clean, Dry Locations: Use plastic nameplates.
   b) Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Manufacturers:
   a) Brady Corporation
   b) Brother International Corporation
   c) Panduit Corp
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.

3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a) System designation where applicable:
      1) Emergency Power System: Identify with text "EMERGENCY".
      2) Fire Alarm System: Identify with text "FIRE ALARM".
   b) Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a) System Designation: 1 inch.
   b) Equipment Designation: 1/2 inch.
5. Color:
   a) Normal Power System: White text on black background.
   b) Emergency Power System: White text on red background.
   c) Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:

1. Brady Corporation
2. HellermannTyton
3. Panduit Corp

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

B. Minimum Size:

1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.

C. Legend:

1. Markers for System Identification:

D. Color: Black text on orange background unless otherwise indicated.

2.05 WARNING SIGNS AND LABELS

A. Manufacturers:

1. Brimar Industries, Inc
2. Clarion Safety Systems, LLC
3. Seton Identification Products

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:

1. Materials:
2. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:

1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Conductors and Cables: Legible from the point of access.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 0553

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 26 0533.13 - Conduit for Electrical Systems.

C. Section 26 0533.16 - Boxes for Electrical Systems.

D. Section 26 2726 - Wiring Devices.

E. Section 26 2816.16 - Enclosed Switches.

F. Section 26 2913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
2. Determine connection locations and requirements.

B. Sequencing:

1. Install rough-in of electrical connections before installation of equipment is required.
2. Make electrical connections before required start-up of equipment.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

1. Colors: Comply with NEMA WD 1.
2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 26 2816.16 and in individual equipment sections.

C. Wiring Devices: As specified in Section 26 2726.

D. Flexible Conduit: As specified in Section 26 0533.13.

E. Wire and Cable: As specified in Section 26 0519.

F. Boxes: As specified in Section 26 0533.16.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION 26 0583

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors.

B. Time switches.

C. In-wall time switches.

D. Lighting contactors.

E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 25 3626 - Integrated Automation Lighting Relays.

B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

C. Section 26 0526 - Grounding and Bonding for Electrical Systems.

D. Section 26 0529 - Hangers and Supports for Electrical Systems

E. Section 26 0533.16 - Boxes for Electrical Systems.

F. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

G. Section 26 5100 - Interior Lighting.

H. Section 26 5600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

C. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

E. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.

F. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.

G. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.

J. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

K. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

L. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

M. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

N. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

O. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.
2. Coordinate placement of wall switch occupancy sensors with installed door swings.
3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.

4. Coordinate placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement.
5. Coordinate lighting control device product selections with luminaire characteristics; see Section 26 5100 and lighting fixture schedule.
6. Notify Architect of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:

1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.

D. Field quality control reports.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include detailed information on device programming and setup.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for occupancy sensors.

C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

PART 2 - PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for purpose intended.

B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

A. Manufacturers:

1. Hubbell Incorporated
2. Lutron Electronics Company, Inc
3. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

B. General Requirements:

1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
   a) Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and ultrasonic technologies.
3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during adjustable turn-off delay time interval.
5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
7. Sensitivity: Field adjustable.
8. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above selected level.
9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
10. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.

C. Wall Switch Occupancy Sensors:

1. General Requirements:
   a) Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees,

integrated manual control capability, and no leakage current to load in off mode.

b) Unless otherwise indicated or required to control load indicated on drawings, provide line voltage units with self-contained relay.

c) Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.

d) Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.

e) Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.

f) Finish: Color to be selected by Architect..

2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within area of 900 square feet.

D. Wall Dimmer Occupancy Sensors:

1. General Requirements:

a) Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.

b) Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.

c) Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.

d) Provide field adjustable dimming preset for occupied state.

e) Finish: Color to be selected by Architect.

E. Ceiling Mounted Occupancy Sensors:

1. General Requirements:

a) Description: Low profile occupancy sensors designed for ceiling installation.

b) Unless otherwise indicated or required to control load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.

c) Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.

d) Finish: White unless otherwise indicated.

2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
   a) Standard Range Sensors: Capable of detecting motion within area of 450 square feet at mounting height of 9 feet, with field of view of 360 degrees.
3. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
   a) Standard Range Sensors: Capable of detecting motion within area of 450 square feet at mounting height of 9 feet, with field of view of 360 degrees.
   b) Extended Range Sensors: Capable of detecting motion within area of 1,200 square feet at mounting height of 9 feet, with field of view of 360 degrees.
4. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
   a) Extended Range Sensors: Capable of detecting motion within area of 1,200 square feet at mounting height of 9 feet.

F. Directional Occupancy Sensors:

1. General Requirements:
   a) Description: Occupancy sensors designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
   b) Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
   c) Provide field selectable setting for disabling LED motion detector visual indicator.
   d) Finish: White unless otherwise indicated.
2. Passive Infrared (PIR) Directional Occupancy Sensors:
   a) Standard Range Sensors: Capable of detecting motion within distance of 40 feet at mounting height of 10 feet.
   b) Long Range Sensors: Capable of detecting motion within distance of 80 feet at mounting height of 10 feet.
3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within distance of 40 feet at mounting height of 10 feet.

G. Power Packs for Low-Voltage Occupancy Sensors:

1. Description: Plenum rated, self-contained low-voltage class 2 transformer and relay compatible with specified low-voltage occupancy sensors for switching of line-voltage loads.
2. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Load Rating: As required to control load indicated on drawings.

2.03 TIME SWITCHES

A. Manufacturers:

1. Intermatic, Inc
2. NSI Industries LLC
3. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

B. Digital Electronic Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
   a) 24-Hour Time Switches: Single channel, with same schedule for each day of week and skip-a-day feature to omit selected days.
   b) 7-Day Time Switches: Single channel, capable of different schedule for each day of week with additional holiday schedule available to override normal schedule for selected days.
   c) Astronomic Time Switches: Single channel, capable of different schedule for each day of week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
3. Schedule Capacity: Not less than 16 programmable on/off operations.
4. Provide automatic daylight savings time and leap year compensation.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Provide remote photocell input with light level adjustment.
8. Input Supply Voltage: As indicated on the drawings.
9. Output Switch Configuration: As required to control load indicated on drawings.
10. Output Switch Contact Ratings: As required to control load indicated on drawings.
11. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:
    a) Indoor clean, dry locations: Type 1.
    b) Outdoor locations: Type 3R.
12. Provide flush-mounted unit where indicated, where mounted in public areas, or where mounted adjacent to flush-mounted equipment.

C. Electromechanical Time Switches:

1. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, listed and labeled as complying with UL 917.
2. Program Capability:
   a) 24-Hour Time Switches: With same schedule for each day of week and skip-a-day feature to omit selected days.
   b) 7-Day Time Switches: Capable of different schedule for each day of week.
   c) Astronomic Time Switches: With same schedule for each day of week and skip-a-day feature to omit selected days with automatic adjustment for seasonal changes in sunrise and sunset times.
3. Schedule Capacity:
4. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
5. Input Supply Voltage: As indicated on the drawings.
6. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:

2.04 IN-WALL TIME SWITCHES

A. Digital Electronic In-Wall Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
3. Schedule Capacity: Not less than 40 programmable on/off operations.
4. Provide power outage backup to retain programming and maintain clock.
5. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
6. Switch Configuration: Suitable for use in either SPST or 3-way application.
7. Contact Ratings: As required to control load indicated on drawings.

2.05 LIGHTING CONTACTORS

A. Manufacturers:

1. ABB/GE
2. Eaton Corporation
3. Rockwell Automation Inc; Allen-Bradley Products;
4. Schneider Electric; Square D Products
5. Siemens Industry, Inc;

B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on drawings.

C. Short Circuit Current Rating:

1. Provide contactors with listed short circuit current rating not less than available fault current at installed location as indicated on the drawings.

D. Enclosures:

1. Comply with NEMA IA 10030.
2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a) Indoor Clean, Dry Locations: Type 1 or Type 12.
   b) Outdoor Locations: Type 3R or Type 4.
3. Finish: Manufacturer's standard unless otherwise indicated.

2.06 ACCESSORIES

A. Auxiliary Contacts:

1. Comply with NEMA IA 10039.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Install lighting control relays; see Section 25 3626

C. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 26 0533.16.

1. Mounting Heights: Unless otherwise indicated, as follows:
   a) Wall Switch Occupancy Sensors: 48 inches above finished floor.
   b) In-Wall Time Switches: 48 inches above finished floor.
   c) In-Wall Interval Timers: 48 inches above finished floor.
2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

D. Maintain separation of remote-control, signaling, and power-limited circuits.

1. See manufacturer instructions and Section 26 0519 for control wiring conductors, wiring methods, and identification requirements.

E. Install lighting control devices in accordance with manufacturer's instructions.

F. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

G. Install lighting control devices plumb and level, and held securely in place.

H. Where required and not furnished with lighting control device, provide wall plate; see Section 26 2726.

I. Provide required supports; see Section 26 0529.

J. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

K. Occupancy Sensor Locations:

1. Location Adjustments: Within design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

L. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near sensor location.

M. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

N. Where indicated or required, provide cabinet or enclosure for mounting of lighting control device system components; see Section 26 0533.16.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test time switches to verify proper operation.

E. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of installed lighting control devices.
4. Location: At project site.

END OF SECTION 26 0923

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General purpose transformers.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0533.13 - Conduit for Electrical Systems: Flexible conduit connections.

E. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.

F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 26 0916 - Electric Controls and Relays: Industrial control transformers.

H. Section 26 2416 - Panelboards.

1.03 REFERENCE STANDARDS

A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.

B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2025.

C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.

F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

G. NEMA ST 20 - Dry Type Transformers for General Applications; 2021.

H. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.

K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

D. Manufacturer's equipment seismic qualification certification.

E. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.

F. Field Quality Control Test Reports.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Maintenance Data: Include recommended maintenance procedures and intervals.

I. Project Record Documents: Record actual locations of transformers.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. 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.

1.08 FIELD CONDITIONS

A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.

1. Greater than 10 kVA: 104 degrees F maximum.
2. Less than 10 kVA: 77 degrees F maximum.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation

B. Schneider Electric; Square D Products

C. Siemens Industry, Inc

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:

1. Altitude: Less than 3,300 feet.
2. Ambient Temperature:
   a) Greater than 10 kVA: Not exceeding 104 degrees F.
   b) Less than 10 kVA: Not exceeding 77 degrees F.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase.

D. Insulation System and Allowable Average Winding Temperature Rise:

1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

E. Coil Conductors: Continuous copper windings with terminations brazed or welded.

F. Winding Taps:

1. Less than 3 kVA: None.
2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.

H. Sound Levels: Standard sound levels complying with NEMA ST 20

I. Mounting Provisions:

1. Less than 15 kVA: Suitable for wall mounting.
2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

J. Transformer Enclosure: Comply with NEMA ST 20.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a) Indoor clean, dry locations: Type 2.
   b) Outdoor locations: Type 3R.
2. Construction: Steel.
   a) Less than 15 kVA: Totally enclosed, non-ventilated.
   b) 15 kVA and Larger: Ventilated.
3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
4. Provide lifting eyes or brackets.

K. Accessories:

1. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Install transformers plumb and level.

G. Transformer Support:

1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.
2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

K. Identify transformers in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

1. 167 kVA single phase, 500 kVA three phase and smaller:
   a) Perform turns ratio tests at all tap positions.
2. Larger than 167 kVA single phase and 500 kVA three phase:
   a) Verify that control and alarm settings on temperature indicators are as specified.
   b) Perform excitation-current tests on each phase.
   c) Measure the resistance of each winding at each tap connection.
   d) Perform an applied voltage test on all high- and low-voltage windings-to-ground.

3.04 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2200

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

G. Section 26 4300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e (Amended 2017).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

E. NEMA PB 1 - Panelboards; 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.

G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

O. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

P. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.

D. Manufacturer's equipment seismic qualification certification.

E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. 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.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation

B. Schneider Electric; Square D Products

C. Siemens Industry, Inc

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature:
   a) Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a) Indoor Clean, Dry Locations: Type 1.
   b) Outdoor Locations: Type 3R.
2. Boxes: Galvanized steel unless otherwise indicated.
   a) Provide wiring gutters sized to accommodate the conductors to be installed.
   b) Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.

c) Provide removable end walls for NEMA Type 1 enclosures.
d) Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.

3. Fronts:
a) Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
b) Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
c) Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.

L. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

M. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

N. Load centers are not acceptable.

O. Provide the following features and accessories where indicated or where required to complete installation:

1. Feed-through lugs.
2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase and Neutral Bus Material: Copper.
2. Ground Bus Material: Copper.

D. Circuit Breakers:

1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.

E. Enclosures:

1. Provide surface-mounted enclosures unless otherwise indicated.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Copper.
3. Ground Bus Material: Copper.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:

1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
   a) Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
   b) Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
   a) Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated:
   a) Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b) Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   c) Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
   d) 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
   e) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
7. Do not use tandem circuit breakers.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide the following features and accessories where indicated or where required to complete installation:
   a) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
   b) Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.06 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

I. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

J. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

K. Provide grounding and bonding in accordance with Section 26 0526.

L. Install all field-installed branch devices, components, and accessories.

M. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.

N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

O. Provide filler plates to cover unused spaces in panelboards.

P. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:

1. Fire detection and alarm circuits.

Q. Identify panelboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

E. Test GFCI circuit breakers to verify proper operation.

F. Test AFCI circuit breakers to verify proper operation.

G. Test shunt trips to verify proper operation.

H. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2416

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Wall plates and covers.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0533.16 - Boxes for Electrical Systems.

D. Section 26 0533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 0583 - Wiring Connections: Cords and plugs for equipment.

G. Section 26 0923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

M. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1. Wall Dimmers: Include derating information for ganged multiple devices.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data:

1. Wall Dimmers: Include information on operation and setting of presets.
2. GFCI Receptacles: Include information on status indicators.

E. Project Record Documents: Record actual installed locations of wiring devices.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
3. Extra Keys for Locking Switches: Two of each type.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 - PRODUCTS

2.01 WIRING DEVICES - GENERAL REQUIREMENTS

A. Provide wiring devices suitable for intended use with ratings adequate for load served.

B. Except where explicitly permitted, substitution of combination switch-and-receptacle devices for separate switches and receptacles is not permitted.

C. Prewired Wiring Device and Outlet Box Assemblies: Factory-assembled products complying with requirements for wiring devices, boxes, and wiring methods may be used in lieu of field-assembled products.

1. Wiring: See Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
2. Boxes: See Section 26 0533.16 - Boxes for Electrical Systems.

D. Wiring Device Applications:

1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.
2. Receptacles Installed in Dwelling Units: Use tamper-resistant receptacles.
3. Provide GFCI protection for:
   a) Receptacles installed within 6 feet of sinks.
   b) Receptacles installed in kitchens.
   c) Receptacles serving electric drinking fountains.
4. Single Receptacles Installed on Individual Branch Circuits: Provide receptacle ampere rating equal to branch circuit rating.
5. Flush Floor Service Fittings in Tile Floors: Use tile rings.
6. Flush Floor Service Fittings in Carpeted Floors: Use carpet flanges.

E. Wiring Device Finishes:

1. Provide wiring device finishes as selected by the Architect.

2.02 WALL SWITCHES

A. Manufacturers:

1. Hubbell Incorporated
2. Leviton Manufacturing Company, Inc
3. Pass & Seymour, a brand of Legrand North America, Inc

B. General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as

complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

C. Standard Wall Switches: Commercial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

D. Pilot Light Wall Switches: Commercial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.03 RECEPTACLES

A. Manufacturers:

1. Hubbell Incorporated
2. Leviton Manufacturing Company, Inc
3. Pass & Seymour, a brand of Legrand North America, Inc

B. General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

3. Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
4. Tamper Resistant and Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

1. General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
   a) Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
4. Tamper Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
5. Tamper Resistant and Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

E. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.

2.04 WALL PLATES AND COVERS

A. Manufacturers:

1. Hubbell Incorporated
2. Leviton Manufacturing Company, Inc
3. Lutron Electronics Company, Inc
4. Pass & Seymour, a brand of Legrand North America, Inc

B. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. Weatherproof Receptacle Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

F. Weatherproof Receptacle Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

G. Verify that core drilled holes for poke-through assemblies are in proper locations.

H. Verify that openings in access floor are in proper locations.

I. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.

1. Mounting Heights: Unless otherwise indicated, as follows:
   a) Wall Switches: 48 inches above finished floor.
   b) Wall Dimmers: 48 inches above finished floor.
   c) Fan Speed Controllers: 48 inches above finished floor.
   d) Receptacles: 18 inches above finished floor or 6 inches above counter.
2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.

K. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 2726

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 2813 - Fuses.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation

B. Schneider Electric; Square D Products

C. Siemens Industry, Inc

D. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. Minimum Ratings:
   a) Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

b) Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.

G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

H. Provide with switch blade contact position that is visible when the cover is open.

I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

J. Conductor Terminations: Suitable for use with the conductors to be installed.

K. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

L. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

M. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a) Indoor Clean, Dry Locations: Type 1.
   b) Outdoor Locations: Type 3R.
2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

N. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

O. Heavy Duty Switches:

1. Comply with NEMA BS 31047.
2. Conductor Terminations:
   a) Provide mechanical lugs unless otherwise indicated.
   b) Lug Material: Copper, suitable for terminating copper conductors only.
3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
   a) Provide means for locking handle in the ON position where indicated.

P. Provide the following features and accessories where indicated or where required to complete installation:

1. Hubs: As required for environment type; sized to accept conduits to be installed.
2. Integral fuse pullers.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2816.16

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:

1. Magnetic motor starters.
2. General purpose contactors.
3. Manual motor starters.
4. Motor-starting switches without overload protection.

B. Overcurrent protective devices for motor controllers, including overload relays.

C. Control accessories:

1. Auxiliary contacts.
2. Pilot devices.
3. Control and timing relays.
4. Control power transformers.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 2813 - Fuses: Fuses for fusible switches.

1.03 REFERENCE STANDARDS

A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

E. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.

F. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.

G. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

H. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

L. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

M. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
3. Coordinate the work to provide controllers and associated wiring suitable for interface with control devices to be installed.
4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
6. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Project Record Documents: Record actual installed locations of controllers and final equipment settings.

1. Include nameplate data of actual installed motors and associated overload relay selections and settings.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation

B. Rockwell Automation, Inc; Allen-Bradley Products

C. Schneider Electric; Square D Products

2.02 ENCLOSED CONTROLLERS

A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:

1. Provide controllers and associated components suitable for operation under the following service conditions without derating:
   a) Altitude:
      1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.
      2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.

b) Ambient Temperature: Between 32 degrees F and 104 degrees F.

2. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:

1. Provide controllers with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Enclosures:

1. Comply with NEMA IA 10030.
2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a) Indoor Clean, Dry Locations: Type 1 or Type 12.
   b) Outdoor Locations: Type 3R or Type 4.
   c) Hazardous (Classified) Locations: Type 7/9, as required for the classification of the installed location.
3. Finish: Manufacturer's standard unless otherwise indicated.

H. Instrument Transformers:

1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

I. Magnetic Motor Starters: Combination type unless otherwise indicated.

1. Combination Magnetic Motor Starters: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
2. Configuration: Full-voltage non-reversing unless otherwise indicated.
3. Disconnects: Circuit breaker type.
   a) Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
   b) Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
   c) Provide auxiliary interlock for disconnection of external control power sources where applicable.
4. Overload Relays: Bimetallic thermal type unless otherwise indicated.

J. General Purpose Contactors: Combination type unless otherwise indicated.

1. Combination Contactors: NEMA ICS 2, Class A combination controllers with magnetic contactor(s) and externally operable disconnect, but without integral overload relay(s).
2. Configuration: Full-voltage non-reversing unless otherwise indicated.
3. Disconnects: Circuit breaker type.
   a) Circuit Breakers: Thermal magnetic unless otherwise indicated or required.
   b) Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
   c) Provide auxiliary interlock for disconnection of external control power sources where applicable.

K. Manual Motor Starters:

1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).
2. Configuration: Non-reversing unless otherwise indicated.
3. Fractional-Horsepower Manual Motor Starters:
   a) Furnish with toggle operator.
   b) Overload Relays: Bimetallic or melting alloy thermal type.
4. Integral-Horsepower Manual Motor Starters:
   a) Furnish with toggle or pushbutton operator.
   b) Overload Relays: Bimetallic or melting alloy thermal type.

L. Motor-Starting Switches: Horsepower-rated switches without overload protection; toggle operator.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:

1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
3. Trip-free operation.
4. Visible trip indication.
5. Resettable.

a) Employ manual reset unless otherwise indicated.
b) Do not employ automatic reset with two-wire control.

6. Bimetallic Thermal Overload Relays:
   a) Interchangeable current elements/heaters.
   b) Adjustable trip; plus/minus 10 percent of nominal, minimum.
   c) Trip test function.
7. Melting Alloy Thermal Overload Relays:
   a) Interchangeable current elements/heaters.

B. Fusible Disconnect Switches:

1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA BS 31047, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
2. Fuse Clips: As required to accept indicated fuses.
3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

C. Circuit Breakers:

1. Interrupting Capacity (not applicable to motor circuit protectors):
   a) Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
   b) Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
2. Motor Circuit Protectors:
   a) Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.
   b) Provide field-adjustable magnetic instantaneous trip setting.

2.04 CONTROL ACCESSORIES

A. Auxiliary Contacts:

1. Comply with NEMA IA 10039.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally

open (NO) and one normally closed (NC) spare contact for each magnetic motor starter, minimum.

B. Pilot Devices:

1. Comply with NEMA IA 10039; heavy-duty type.
2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
4. Indicating Lights: Push-to-test type unless otherwise indicated.
5. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:

1. Comply with NEMA IA 10039.
2. Provide number and type of relays indicated or required to perform necessary functions.

D. Control Power Transformers:

1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices, plus _____ percent spare capacity.
2. Include primary and secondary fuses.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings of enclosed controllers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install controllers in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed controllers plumb and level.

F. Provide grounding and bonding in accordance with Section 26 0526.

G. Install all field-installed devices, components, and accessories.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

K. Set field-adjustable circuit breaker tripping function settings as indicated.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.

D. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

E. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers larger than _____ amperes. Tests listed as optional are not required.

F. Correct deficiencies and replace damaged or defective enclosed controllers or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.06 PROTECTION

A. Protect installed enclosed controllers from subsequent construction operations.

END OF SECTION 26 2913

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts and drivers.

E. Lamps.

1.02 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports for Electrical Systems.

B. Section 26 0533.16 - Boxes for Electrical Systems.

C. Section 26 0923 - Lighting Control Devices.

1. Includes automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
2. Includes lighting contactors.

D. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.

E. Section 26 5600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).

B. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.

E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.

F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

J. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

K. UL 1598 - Luminaires; Current Edition, Including All Revisions.

L. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.

M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution upon request.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:
   a) Include estimated useful life, calculated based on IES LM-80 test data.
2. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.

D. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.

C. Provide 5-year pro-rata warranty for batteries for emergency lighting units.

D. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

PART 2 - PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.
2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

H. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.

I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.

1. LED Tape - General Requirements:
   a) Listed.
   b) Designed for field cutting in accordance with listing.
   c) Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.

J. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.

K. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:

1. Sealed maintenance-free lead calcium unless otherwise indicated.
2. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

G. Accessories:

1. Provide compatible accessory mounting brackets where indicated or required to complete installation.

2.04 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single- or double-face as indicated or as required for installed location.
2. Directional Arrows: As indicated or as required for installed location.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.

2.05 BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:

1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:

1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.
   a) Wall Dimmers: See Section 26 2726.

2.06 LAMPS

A. Lamps - General Requirements:

1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.
5. Unless otherwise noted, color temperature shall be 3500k for indoor fixtures and 4000k for exterior fixtures.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

G. Suspended Ceiling Mounted Luminaires:

1. Do not use ceiling tiles to bear weight of luminaires.
2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
3. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
4. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.

5. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

H. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

I. Suspended Luminaires:

1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
2. Install canopies tight to mounting surface.

J. Install accessories furnished with each luminaire.

K. Bond products and metal accessories to branch circuit equipment grounding conductor.

L. Emergency Lighting Units:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

M. Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

N. Install lamps in each luminaire.

O. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 5100

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.

B. Ballasts.

C. Poles and accessories.

D. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0533.16 - Boxes for Electrical Systems.

1.03 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.

B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.

C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.

D. IES RP-8 - Recommended Practice: Lighting Roadway and Parking Facilities; 2025.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

F. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).

G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

J. UL 1598 - Luminaires; Current Edition, Including All Revisions.

K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution upon request.
3. Provide structural calculations for each pole proposed for substitution.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

a) Include estimated useful life, calculated based on IES LM-80 test data.

2. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

D. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

E. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide 2-year manufacturer warranty for all LED luminaires, including drivers.

PART 2 - PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.
2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

I. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.

J. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

K. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.

3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:

1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

2.04 POLES

A. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Structural Design Criteria:
   a) Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
3. Material: Steel, unless otherwise indicated. Fiberglass and Resin poles will not be accepted.
4. Shape: Square straight, unless otherwise indicated.
5. Finish: Match luminaire finish, unless otherwise indicated.
6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
7. Unless otherwise indicated, provide with the following features/accessories:
   a) Top cap.
   b) Anchor bolts with leveling nuts or leveling shims.
   c) Anchor base cover.
   d) Provision for pole-mounted weatherproof GFI receptacle where indicated.

2.05 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires in accordance with NECA/IESNA 501.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

G. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

H. Pole-Mounted Luminaires:

1. Maintain the following minimum clearances:
   a) Comply with IEEE C2.
   b) Comply with utility company requirements.
2. Foundation-Mounted Poles:
   a) Install foundations plumb.
   b) Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
   c) Tighten anchor bolt nuts to manufacturer's recommended torque.
3. Grounding:
   a) Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
4. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.

I. Install accessories furnished with each luminaire.

J. Bond products and metal accessories to branch circuit equipment grounding conductor.

K. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 5600

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 27 1000 - Structured Cabling.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

E. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.

F. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.

G. MFMA-4 - Metal Framing Standards Publication; 2004.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).

L. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
2. Coordinate work to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 3000.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable supports, channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

1. Fiberglass Channel/Strut Framing Systems: Include requirements for strength derating according to ambient temperature.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.06 QUALITY ASSURANCE

A. Maintain at project site one copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
   a) TIA-569.
   b) NFPA 70.
   c) Applicable building code.
   d) Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.

a) Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
b) Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
c) Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
d) Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit Supports: Straps and clamps suitable for conduit to be supported.

1. Manufacturers:
2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
3. Conduit Clamps: Bolted type unless otherwise indicated.

C. Noncontinuous Cable Supports: Suitable for cables to be supported, including but not limited to J-hooks, bridle rings, drive rings, and flexible harnesses/slings.

1. Applications:
a) Do not exceed 5 feet between cable supports.
b) Maximum Number of Cables per Cable Support:
1) J-Hooks: 40 percent of fill capacity.
c) Allowable Cable Types:
1) J-Hooks: Category 3, Category 5e, and Category 6.
2. Cable Supports Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.
3. J-Hooks: Noncontinuous cabling support with removable top retainer clip.
a) Material: Use galvanized steel, factory-painted steel, or stainless steel.
b) Provide support surfaces with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported.
c) Provide multitiered J-hooks where required to support multiple cabling systems.

D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

E. Metal Channel/Strut Framing Systems:

1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Comply with MFMA-4.

F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:

a) Equipment Supports: 1/2-inch diameter.
b) Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
c) Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
d) Trapeze Support for Multiple Conduits: 3/8-inch diameter.
e) Outlet Boxes: 1/4-inch diameter.

G. Nonpenetrating Rooftop Supports for Low-Slope Roofs:

1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

H. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Hammer-driven anchors and fasteners are not permitted.
12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a) Manufacturer: Same as manufacturer of metal channel/strut framing system.
    b) Comply with MFMA-4.
    c) Channel Material: Use galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Provide required seismic controls.

I. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

J. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

K. Secure fasteners in accordance with manufacturer's recommended torque settings.

L. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 27 0529

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Communications system design requirements.

B. Communications pathways.

C. Copper cable and terminations.

D. Communications equipment room fittings.

E. Communications outlets.

F. Communications grounding and bonding.

G. Communications identification.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0533.16 - Boxes for Electrical Systems.

D. Section 26 0553 - Identification for Electrical Systems: Identification products.

1.03 REFERENCE STANDARDS

A. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.

B. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; 2005e.

C. ICEA S-90-661 - Category 3 and 5E Individually Unshielded Twisted Pairs, Indoor Cables (With or Without an Overall Shield) for Use in General Purpose and LAN Communication Wiring Systems; 2021.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2024.

F. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; 2018d, with Addenda (2020).

G. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).

H. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2021d.

I. TIA-607 - Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2024e.

J. UL 444 - Communications Cables; Current Edition, Including All Revisions.

K. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

L. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate requirements for service entrance and entrance facilities with Communications Service Provider.
2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
3. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

D. Evidence of qualifications for installer.

E. Field Test Reports.

F. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

1. Record actual locations of outlet boxes and distribution frames.
2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
3. Identify distribution frames and equipment rooms by room number on drawings.

G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: At least 5 years experience manufacturing products of the type specified.

B. Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:

1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
2. Supervisors and installers factory certified by manufacturers of products to be installed.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Keep stored products clean and dry.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.

1. Comply with TIA-568 (SET) (cabling) and TIA-569 (pathways) (commercial standards).
2. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
3. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
4. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.

B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.

1. Locate main distribution frame as indicated on the drawings.

C. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.02 COPPER CABLE AND TERMINATIONS

A. Manufacturers:

1. CommScope
2. General Cable Technologies Corporation
3. Siemon Company

B. Copper Backbone Cable:

1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2, ICEA S-90-661, and listed and labeled as complying with UL 444; arranged in 25-pair binder groups.
2. Cable Type: TIA-568.2 Category 3 UTP (unshielded twisted pair); 24 AWG.
3. Cable Capacity: Quantity of pairs as indicated on drawings.
4. Cable Applications:
   a) Plenum Applications: Use listed NFPA 70 Type CMP plenum cable.
   b) Riser Applications: Use listed NFPA 70 Type CMR riser cable or Type CMP plenum cable.

C. Copper Horizontal Cable:

1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
2. Cable Type - Voice and Data: TIA-568.2 Category 6 UTP (unshielded twisted pair); 23 AWG.
3. Cable Capacity: 4-pair.
4. Cable Applications: Use listed NFPA 70 Type CMP plenum cable unless otherwise indicated.
5. Cable Jacket Color - Voice and Data Cable: Blue.
6. Product(s):
   a) CommScope; SYSTIMAX Twisted Pair Cables; GigaSPEED XL Category 6 U/UTP Cable
   b) CommScope; Uniprise Twisted Pair Cables; CS34 Series Category 6 U/UTP Cable
   c) General Cable Technologies Corporation; GenSPEED Cables:

D. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.

1. Performance: 500 mating cycles.
2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.
3. Product(s):
   a) CommScope; SYSTIMAX RJ45 Jacks; MGS400 Series Category 6 U/UTP Modular Jacks

b) CommScope; Uniprise RJ45 Jacks; UNJ600 Series Category 6 U/UTP Modular Jacks

E. Copper Patch Cords:

1. Description: Factory-fabricated 4-pair cable assemblies with 8-position modular connectors terminated at each end.
2. Patch Cords for Patch Panels:
   a) Quantity: One for each pair of patch panel ports.
   b) Length: _____ feet.
3. Product(s):
   a) CommScope; SYSTIMAX Category 6 U/UTP Patch Cords
   b) CommScope; Uniprise Category 6 U/UTP Patch Cords

2.03 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

A. Copper Cross-Connection Equipment:

1. Manufacturers:
   a) CommScope
   b) Siemon Company
2. Connector Blocks for Category 5e and Up Cabling: Type 110 insulation displacement connectors; capacity sufficient for cables to be terminated plus 25 percent spare.
3. Patch Panels for Copper Cabling: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum; cabling terminated on Type 110 insulation displacement connectors; printed circuit board interface.
   a) Jacks: Non-keyed RJ-45, suitable for and complying with same standard as cable to be terminated; maximum 48 ports per standard width panel.
   b) Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.
   c) Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
   d) Provide incoming cable strain relief and routing guides on back of panel.
4. Product(s):
   a) CommScope; SYSTIMAX Copper Panels; 360-IPR-1100-XX Series Patch Panels
   b) CommScope; Uniprise Copper Panels; UNP-XX-DM Series Patch Panels

B. Backboards: Interior grade plywood without voids, 3/4 inch thick; UL-labeled fire-retardant.

1. Do not paint over UL label.

C. Equipment Frames, Racks and Cabinets:

1. Manufacturers:
   a) CommScope
   b) Siemon Company
2. Component Racks: EIA/ECA-310 standard 19 inch wide.

D. Cable Management:

1. Manufacturers:
   a) CommScope
   b) Siemon Company
2. Product(s):
   a) CommScope Cable Runway
   b) CommScope Horizontal/Vertical Cable Managers; HCM-SS-XX-XX/VCM-DS-XX-XX Series
   c) CommScope FiberGuide Raceway

2.04 COMMUNICATIONS OUTLETS

A. Manufacturers:

1. CommScope
2. Siemon Company

B. Outlet Boxes: Comply with Section 26 0533.16.

1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
2. Minimum Size, Unless Otherwise Indicated:
   a) Voice Only Outlets: 4 inch by 2 inch by 2-1/8 inch deep (100 by 50 by 54 mm) trade size.
   b) Data or Combination Voice/Data Outlets: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
   c) Fiber Optic Outlets: 4-11/16 inch square by 2-1/8 inch deep (119 by 54 mm) trade size.

C. Wall Plates:

1. Comply with system design standards and UL 514C.
2. Accepts modular jacks/inserts.
3. Capacity:
   a) As indicated on drawings.

2.05 GROUNDING AND BONDING COMPONENTS

A. Comply with TIA-607.

2.06 IDENTIFICATION PRODUCTS

A. Comply with TIA-606.

2.07 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Factory test cables according to TIA-568 (SET).

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), BICSI N1, NFPA 70, and SYSTEM DESIGN as specified in PART 2.

B. Comply with Communication Service Provider requirements.

C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.

3.02 INSTALLATION OF PATHWAYS

A. Install pathways with the following minimum clearances:

1. 48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
2. 12 inches from power conduits and cables and panelboards.
3. 5 inches from fluorescent and high frequency lighting fixtures.
4. 6 inches from flues, hot water pipes, and steam pipes.

B. Outlet Boxes:

1. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of telecommunications outlets provided under this section.
   a) Mounting Heights: Unless otherwise indicated, as follows:
      1) Telephone and Data Outlets: 18 inches above finished floor.
      2) Telephone Outlets for Side-Reach Wall-Mounted Telephones: 54 inches above finished floor to top of telephone.
      3) Telephone Outlets for Forward-Reach Wall-Mounted Telephones: 48 inches above finished floor to top of telephone.

b) Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
c) Provide minimum of 24 inches horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.
d) Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.
e) Locate outlet boxes so that wall plate does not span different building finishes.
f) Locate outlet boxes so that wall plate does not cross masonry joints.

3.03 INSTALLATION OF EQUIPMENT AND CABLING

A. Cabling:

1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
2. Do not over-cinch or crush cables.
3. Do not exceed manufacturer's recommended cable pull tension.
4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:

1. At Distribution Frames: 120 inches.

C. Copper Cabling:

1. Category 5e and Above: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.
2. For 4-pair cables in conduit, do not exceed 25 pounds pull tension.
3. Use T568B wiring configuration.

D. Identification:

1. Use wire and cable markers to identify cables at each end.
2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.
3. Use identification nameplate to identify cross-connection equipment, equipment racks, and cabinets.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Comply with inspection and testing requirements of specified installation standards.

C. Visual Inspection:

1. Inspect cable jackets for certification markings.
2. Inspect cable terminations for color coded labels of proper type.
3. Inspect outlet plates and patch panels for complete labels.

D. Testing - Copper Cabling and Associated Equipment:

1. Test backbone cables after termination but before cross-connection.
2. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.
3. Test operation of shorting bars in connection blocks.
4. Category 3 Backbone: Perform attenuation test.
5. Category 3 Links: Test each pair for short circuit continuity, short to ground, crosses, reversed polarity, operational and ring-back, and dial tone.
6. Category 5e and Above Backbone: Perform near end cross talk (NEXT) and attenuation tests.
7. Category 5e and Above Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay.

E. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

END OF SECTION 27 1000

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system and associated components, including control units, related equipment, initiating devices, and notification appliances.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware:

B. Section 14 2100 - Electric Traction Elevators: For interface with fire alarm system.

C. Section 14 2400 - Hydraulic Elevators: For interface with fire alarm system.

D. Section 21 1300 - Fire-Suppression Sprinkler Systems: For interface with fire alarm system.

E. Section 21 3000 - Fire Pumps: For interface with fire alarm system.

F. Section 23 3300 - Air Duct Accessories: Smoke/fire dampers for interface with fire alarm system.

G. Section 26 0533.16 - Boxes for Electrical Systems.

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

E. NECA 305 - Standard for Fire Alarm System Job Practices; 2018.

F. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.

J. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems; Current Edition, Including All Revisions.

L. UL 268A - Standard for Smoke Detectors for Duct Application; Current Edition, Including All Revisions.

M. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

N. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.

O. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate arrangement of equipment with dimensions and clearance requirements of actual equipment.
2. Coordinate placement of devices and notification appliances with potential conflicts or view obstructions.
3. Coordinate work to provide power for equipment at required locations (e.g., smoke dampers, type of actuators, line or local control transformer, zoning, grouping and circuit activations).
4. Coordinate requirements for branch circuit protection, identification, and shunt trip if applicable.
5. Coordinate reflected ceiling plans to avoid conflicting placements; maintain minimum diffuser and detector clearances as indicated.
6. Coordinate submittals to confirm equipment and associated components are capable of indicated settings, and manufacturer documentation identifies required compatible product listings.
7. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Evidence of designer qualifications.

C. Comply with NFPA 72 chapter "Documentation," including noting names of installers, owners, and system classification information.

D. Design Documents: Submit all information required for plan review and permitting by AHJ, including floor plans, riser diagrams, and description of operation.

1. Copy (if any) of list of data required by AHJ.
2. NFPA 72 "Record of Completion", filled out to extent known at time.
3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A, and complete listing of software required.
4. Manufacturer's detailed product data sheet for each component, including wiring diagrams, and circuit length limitations. Catalog pages and product descriptions include ratings, dimensions, finishes, service conditions, and included features.
5. Certification by manufacturer of FACU that system design complies with Contract Documents.
6. Certification by Contractor that system design complies with Contract Documents.

E. Shop Drawings: Submit installation documentation required for plan review and permitting by AHJ, including floor plans showing locations of fire alarm system components, enlarged drawn to identified scale plan view, and riser diagrams.

1. System zone boundaries and interfaces to fire safety systems.
2. Show locations of components, circuits, and raceways; mark components with identifiers used in control unit programming.
3. Include elevations and details of proposed equipment arrangements.
4. Include system interconnection schematic riser diagram showing proposed and approved cable size and type; coordinated with floor plans and describing circuit class, survivability, and application specific information required by NFPA 72.
5. Include typical wiring diagrams for devices, notification appliances, remote indicators, annunciators, remote test stations, and EoL and power supervisory devices.
6. Include requirements and control diagrams for interfacing with other systems.
7. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; standby and spare capacity calculations; notification appliance circuit loop resistance and voltage drop calculations, including spare capacity.
8. List of devices and notification appliances on each SLC, with spare capacity indicated.
9. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
10. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
11. Detailed drawing of graphic annunciators, displays, and interfaces.
12. Certification by either FACU manufacturer or manufacturer of related equipment.
13. Certification by FACU manufacturer that system design complies with Contract Documents.
14. Certification by Contractor that system design complies with Contract Documents.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Evidence of installer qualifications.

H. Evidence of maintenance contractor qualifications, if different from installer.

I. Inspection and Test Reports:

1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.
3. Submit NFPA 72 "Inspection and Test," filled out.

J. Operating and Maintenance Data: See Section 01 7800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:

1. Complete set of specified design documents, as approved by AHJ.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures require recording of system trouble events by qualified personnel, such as when routine testing is being conducted for fire drills and when entering into contracts for building renovations.

K. Project Record Documents: See Section 01 7800 for additional requirements, have one set available during closeout demonstration:

1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, and updated input/output chart.

L. Closeout Documents:

1. Certification by manufacturer that system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion," filled out completely and signed by installer and authorized representative of AHJ.
3. Certificate of Occupancy.
4. Maintenance contract.

M. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.

1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.
2. In addition to items in quantities indicated in PART 2, furnish the following:
   a) Tools, software, and documentation necessary to modify fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, notification appliances, circuits, and zones, and changes to system description, and operation.
   b) One copy of software not resident in read-only-memory.
   c) Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III (three) or Level IV (four) certified fire alarm technician or registered fire protection engineer, employed by FACU manufacturer, Contractor, or installer, with experience designing fire alarm systems in jurisdictional area of AHJ.

B. Installer Qualifications: Firm with minimum three years documented experience installing fire alarm systems of specified type and providing contract maintenance service as regular part of their business.

1. Authorized representative of FACU manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least two years of experience installing fire alarm systems.
3. Supervisor: Level III (three) or Level IV (four) certified fire alarm technician; furnish name and address.
4. Contract maintenance office located within 50 miles of project site.
5. Certified in the State in which the Project is located as fire alarm installer.

C. Manufacturer Qualifications: Company specialized in manufacturing products specified in this section with at least three years of documented experience.

D. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 305.

C. Handle carefully to avoid damage to internal components, enclosure, and finish.

D. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

B. Do not exceed maximum ambient temperature requirements for batteries at any time, which reduces battery service life. Replace batteries exposed to temperatures in excess of manufacturer's requirements.

C. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Fire Alarm Control Units and Accessory Equipment: Provide minimum 3-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

C. Fire Alarm Manual Pull Stations: Provide minimum 1-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

D. Fire Alarm System Detectors: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

E. Fire Alarm System Notification Appliances: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 FIRE ALARM SYSTEM

A. General Requirements:

1. Provide new fire alarm system complying with NFPA 70, NFPA 72, NFPA 90A, and consisting of required equipment, conduit, cabinets, outlet boxes, wiring, connectors, hardware, supports, accessories, components, software, and system programming as necessary for complete operating system that provides functional intent indicated.
2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
   a) 36 CFR 1191 and ADA Standards.
   b) Requirements of AHJ.
   c) Applicable local codes.
   d) Contract Documents.
   e) NFPA 72; "should" is mandatory; where conflicts between requirements require deviation, identify deviations clearly on design documents.
3. Fire Alarm System Products:
   a) Listed, classified, and labeled as suitable for purpose intended.
   b) Installation Environments: Provide products suitable for their respective indoor and outdoor applications.
4. Fire Alarm System Design Information:

a) Building Code: Comply with applicable building code.
   1) Principle Occupancy: As indicated on Architect code summary drawings.
   2) Principle Use: As indicated on Architect code summary drawings.
b) NFPA 72 Fire Alarm System Classification: Protected premises.

5. Provide fire alarm circuits in accordance with NFPA 70.
   a) Comply with methods of interconnecting FACUs in accordance with NFPA 72 and NFPA 70.
   b) Power Sources:
      1) Comply with requirements for power supplies of emergency systems in accordance with NFPA 70.
      2) Primary: Dedicated branch circuits from facility power distribution system.
      3) Secondary: Storage batteries with capacity to operate system for period specified by NFPA 72.
   c) Wiring and Wiring Methods:
      1) General Requirements:
         (a) Comply with requirements for wiring and wiring methods in accordance with NFPA 70.
         (b) Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum-rated, listed and labeled as suitable for use in return air plenums.
         (c) Special Occupancies: Comply with NFPA 70.
         (d) Comply with NFPA 70 for wire and cable plenum, riser, general-purpose, limited-use, undercarpet, and underground applications.
      2) Fire Alarm Circuits:
         (a) Comply with NFPA 70 for conditions and types required for multiconductor cable systems.
         (b) Non-Power-Limited Fire Alarm (NPLFA) Circuits:
            (1) Provide dedicated NPLFA non-GFCI branch circuits for fire alarm equipment and marked by red identification in accordance with NFPA 70.
         (c) Power-Limited Fire Alarm (PLFA) Circuits:
            (1) Provide identification for PLFA circuits in accordance with NFPA 70.

6. Provide pathway class designations and pathway survivability, as defined in NFPA 72.
   a) Provide monitoring of conductors and other signaling channels for integrity and circuit performance.
   b) Pathway Class Designations:
      1) Unless otherwise indicated or required, pathways to meet the following requirements:
         (a) SLCs: Class B (star, tee-tap, multi-tap, with no return).

(b) IDCs: Class B (daisy-chain with EoL resistor device installed at end of circuit).
(c) NACs: Class B (daisy-chain with EoL resistor device installed at end of circuit).

B. Fire Alarm System Interfaces and Control Functions:

1. UL 864 listed unless otherwise indicated.
2. Descriptions below are intended to provide means for interface. See project SOOs, narrative, and input/output matrix for execution requirements.
3. Provide initiating devices, interfaces, and control functions for emergency control function interfaces in accordance with NFPA 72.
4. Provide monitoring of interconnected systems. Coordinate notification appliance alternate markings as indicated on drawings.
5. HVAC Systems:
   a) Air Handling Units (AHUs) and Roof Top Units (RTUs):
      1) Provide duct smoke detector on supply side of air stream for units over 2,000 cfm.
      2) Provide duct smoke detector on return side of air stream for units over 15,000 cfm.
      3) Provide remote test station for each duct smoke detector unless explicitly indicated as not required.
      4) Provide output signal to shut down units with at least one duct smoke detector via addressable relay module.
      5) Where fire/smoke dampers are located downstream of unit, provide monitoring point input to determine that unit is not operational and subsequently provide output signal to close such dampers via addressable relay module and power isolation relay.
   b) Energy Recovery Units (ERUs):
      1) Provide duct smoke detector on supply side of air stream.
      2) Provide duct smoke detector on return side of air stream.
      3) Provide remote test station for each duct smoke detector unless explicitly indicated as not required.
      4) Provide output signal to shut down units with at least one duct smoke detector via addressable relay module.
      5) Where fire/smoke dampers are located downstream of unit, provide monitoring point input to determine that unit is not operational and subsequently provide output signal to close such dampers via addressable relay module and power isolation relay.
   c) Remote Test Stations: Provide remote test station for each duct smoke detector unless explicitly indicated as not required. Unless otherwise

indicated, use remote test stations only in clean, dry, indoor, nonhazardous locations.

6. High Volume Low Speed (HVLS) Fans:
    a) Provide interlocked shut down of all HVLS fans upon activation of waterflow switch, in accordance with NFPA 13 and NFPA 72.
    b) HVLS Fan Shutoff:
        1) Provide output signal to stop fans via addressable relay module and power isolation relay.

2.02 FIRE ALARM CONTROL UNITS AND RELATED EQUIPMENT

A. Manufacturers:

1. Owners Vendor.

B. Fire Alarm Control Units and Related Equipment: Listed and labeled as complying with UL 864.

C. Provide cabinets and enclosures as indicated or as required to house system components.

D. Fire Alarm Control Unit (FACU): Addressable.

1. SLCs and IDCs: Configurable for Class B or Class A with additional modules.
2. NACs: Integral and programmable with synchronization modules or cards as required.
3. Power Supply: 120 VAC, 60 Hz, supplying necessary power for FACU.
4. User-Interface: Touchscreen display for system interfacing and service mode settings, include password and user credentials; configurable for custom actions and incorporates historical event log.
5. Support self-testing detector capability.
6. Remote Annunciator Support: Up to 10.

2.03 FIRE ALARM SYSTEM INITIATING DEVICES

A. General Requirements:

1. Provide devices and associated accessories suitable for intended application and location to be installed. Unless otherwise indicated, use addressable devices and addressable interface modules only in clean, dry, indoor, nonhazardous locations.
2. Surface-Mounted Devices: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.

3. Devices for Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes or enclosures in accordance with product listing.
4. Devices for Hazardous/Classified Locations: Listed and labeled as suitable for classification of installed location.

B. Manual Fire Alarm Boxes/Pull Stations:

1. Description: Noncoded manual signaling boxes listed and labeled as complying with UL 38.
2. Alarm Initiation: Configured for general alarm initiation unless otherwise indicated; presignal stations (where indicated) require use of key to initiate general alarm.
3. Operation: Dual-action unless otherwise indicated or required.
   a) Dual-Action Operation: First requires pushing, pulling, or lifting, then pulling of lever.
4. Color: Red, in accordance with NFPA 72.
5. Station Reset: Requires use of key or tool.

C. Duct Smoke Detectors:

1. Listed and labeled as complying with UL 268A.
2. Ratings: Compatible with air velocity, temperature, and humidity requirements for installed duct.
3. Housing: Select as required for application.
4. Sampling Tubes: Select as required for installation in duct to be monitored.

2.04 FIRE ALARM SYSTEM NOTIFICATION APPLIANCES

A. General Requirements:

1. Provide signaling notification appliances listed for fire-protective service and intended operating mode, public or private; suitable for connection to FACU notification appliance circuits.
2. Provide notification appliances and associated accessories suitable for intended application and location to be installed. Use notification appliances only according to listed mounting (e.g. ceiling, wall).
3. Surface-Mounted Notification Appliances: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
4. Exterior Notification:
   a) In addition to required occupant notification, provide notification appliances on exterior of building.
5. Notification Appliance Derating: Include device derating adjustments in accordance with listing where applicable, including the following.

a) Where accessory protective guards or enclosures are utilized.
b) Where required by field conditions (e.g., ambient temperature and sound).

B. Visible Notification Appliances:

1. Public Mode Operation: Listed and labeled as complying with UL 1971.

C. Audible Notification Appliances:

1. Listed and labeled as complying with UL 464.
2. Rated Sound Pressure Level: As required to achieve design sound pressure levels, but not less than 75 dBA at 10 feet for public mode operation or 45 dBA at 10 feet for private mode operation in accordance with UL 464.

2.05 WIRE AND CABLE

A. General Requirements:

1. Provide cables as indicated or as required for connections between system components.

2.06 ACCESSORIES

A. Provide components as indicated or as required for connection of fire alarm system to devices and other systems indicated.

B. Provide EoL resistors as required for wiring supervision.

C. Surge Protection:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that mounting surfaces are ready to accept components and equipment, with suitable support frames and anchors installed where required.

B. Verify ratings, configurations, and characteristics of system components.

C. Verify rough-ins for field connections.

D. Verify that work likely to damage fire alarm system has been completed.

E. Verify that interior of building has been protected from weather.

F. Perform preinstallation tests and inspections per manufacturer's instructions and in accordance with NECA 305.

G. Verify that system bonding is in accordance with Section 26 0526.

H. Do not energize system until deficiencies have been corrected.

I. Verify that branch circuit wiring installation is completed, tested, and ready for connection to fire alarm system. Overcurrent protection ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

3.02 PREPARATION

A. Prior to installation, confirm environment of installation area is clean, and with ambient temperature, humidity, and ventilation requirements are per manufacturer’s written instructions.

1. Clean and vacuum in accordance with manufacturer's written instructions. Confirm equipment ventilation holes are absent of obstructions and free for air flow.
2. Clean pathways thoroughly to remove foreign materials before installing conductors and cables.
3. Clean dirt, debris, plaster, and other foreign materials from equipment enclosures, cabinets, and outlet boxes.
4. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Follow tool requirements for installation, including torquing adjustments, as listed in manufacturer documentation.

C. Remove detector dust covers prior to system energization.

3.03 INSTALLATION

A. Install field-devices, components, FACU and related equipment, and accessories in accordance with the following:

B. Field Locations:

1. Obtain Owner's approval of locations of devices and notification appliances before installation.
2. Arrange equipment to provide minimum operational clearances and required maintenance access in accordance with manufacturer's instructions and NFPA 70.
3. Conceal wiring, conduit, outlet boxes, and supports where installed in finished areas; maintain code-required access.

C. Raceways and Supports:

1. Coordinate locations of outlet boxes as required for installation. Only install boxes and equipment at locations based on application standards indicated in NFPA 72.
2. Secure and support raceways at intervals complying with NFPA 70. Provide supports where vertical rise exceeds permissible limits.
3. Install firestopping to preserve fire resistance rating of partitions and other elements.

D. Wiring and Connections:

1. Maintain separation of Class 1, Class 2, Class 3 remote-control, signaling, fire alarm circuits, and power-limited circuits in accordance with cable insulation class and NFPA 70.
2. Maintain circuit pathway and class designations in accordance with NFPA 72 for configuration, separation, and survivability.
3. Comply with permitted and not permitted installations for wires, cables, cable routing assemblies, communications circuits, and fire alarm circuits in accordance with NFPA 70.
4. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by AHJ. Provide independent support from building structure and suspended ceiling systems. Do not provide support from raceways, piping, ductwork, or other systems.
5. Provide grounding and bonding in accordance with Section 26 0526.
6. Comply with manufacturer's minimum cable sizes or ratings.
7. Do not exceed manufacturer's recommended maximum power, signal, or network cable lengths between components.
8. Provide network wiring in accordance with NFPA 70.
9. Neatly train and bundle conductors inside boxes, wireways, and cabinets.
10. See manufacturer's instructions for batteries.

E. Fire Alarm System Components:

1. Install field-installed devices, components, relays, notification appliances, accessories, and when applicable EoL resistors.
    a) Install wiring to supervisory devices and associated EoL resistors as required for supervision of hardwired connections

2. Install Wall-Mounted Equipment: Assemble component hardware within (e.g., card bays, sub-bays, expansion bays, signal cards, other card frames, networking, signal transmission, application modules, tamper monitoring devices, interconnecting modules, and auxiliary power supplies), including space for required spare capacity, and configure settings.
3. Install Interconnect Wiring: Connect system cabinets, install processor and cards, cabling, connectors, terminations, and bonding.

F. Branch Power:

1. After installation confirmations, follow manufacturer instructions to connect branch circuit power cables to premises fire alarm system components; comply with NFPA 70.
2. Where accessories require auxiliary power, provide control power source and monitoring as indicated or as required to complete installation.
3. Install auxiliary power supplies, including indicated monitoring, and connections necessary for remote equipment.

G. System Identification:

1. Identify devices, notification appliances, components, cables, and equipment in accordance with approved submittals. See Section 26 0553.
2. Confirm fire alarm system programming meets requirements of SOO and sub-system SOOs.
3. Mark location of disconnecting means for NPFLA circuits.
4. Coordinate to provide red branch power circuit protective devices or identify them accordingly as required by NFPA 72 and NFPA 70.
5. Mark date of batteries installed on inside cover of panels and formal maintenance logs.

H. Troubleshooting and Installer Checks:

1. Field test connectivity periodically during installation process to avoid unexpected troubleshooting.
2. Check system operation for notification, FACU functions, circuit supervision, alarm initiating devices, supervisory initiating devices, dress panels/doors/covers, and programming before performing field tests.

I. Fire Alarm System Tests:

1. Perform required tests of NFPA 72. Record measured values during operational checks.
2. Confirm functional testing of fire alarm system is as indicated in Contract Documents.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide services of manufacturer's authorized representation to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's detailed testing procedures and field reports and with submittals.

C. Provide equipment, two-way radios for testing personnel use, tools, and supplies required to accomplish inspection and testing.

D. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.

E. Inspect and test in accordance with manufacturer's instructions.

F. Inspect wiring and components for damage and defects.

G. Batteries and Power Supplies: Perform inspections and tests listed in manufacturer installation instructions.

H. Perform additional requirements related to testing and inspection during system startup.

I. Test for interface with other systems.

J. Test shunt trips to verify operation.

K. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.

L. Submit detailed reports indicated inspection and testing results, corrective actions taken, and as-found and final adjusted settings.

3.05 SYSTEM STARTUP

A. Obtain Owner approval prior to performing system startup.

3.06 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust initiating device and notification appliance settings to achieve desired operation as indicated in submittals.

C. Measure power supply primary and secondary voltages, log values for records, and make appropriate adjustments.

D. Adjust alignment of equipment covers and doors. Provide keys and spare keys to Owner.

E. Reprint and reinstall damaged or misinstalled labels; maintain neat and square to installed location good workmanship - see NECA 1; maintain consistent placements for identification on products of similar type.

F. Adjust devices or notification appliances and associated bases to be flush and level.

G. Program system parameters according to requirements of Owner.

3.07 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. See Section 01 7419 - Construction Waste Management and Disposal for field-generated construction waste requirements.

C. Check tightness of electrical connections. Replace damaged components and provide closure plates for vacant positions. Provide circuit directory updates for related power branch circuits.

D. Clean and repair existing materials and equipment that remain or are indicated for reuse.

E. Clean dirt, debris, plaster, and other foreign materials from outlet boxes and fire alarm system equipment and components.

F. Clean fire alarm system equipment and components according to manufacturer's instructions and NECA 305.

G. Clean surfaces and interiors of boxes and device cover plates in accordance with manufacturer's instructions to remove dirt, fingerprints, debris, plaster, and other foreign materials.

H. Repair scratched or marred exposed surfaces to match original factory finish.

I. Comply with federal (EPA), state, and local regulations for battery handling and disposal. Do not spill battery fluids down plumbing drains. Only use containers safe for transportation marked 'nonspillable.'

3.08 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify AHJ and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide services of installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required.

E. Provide tools, software, and supplies required to accomplish inspection, testing, and document results.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of AHJ; document each inspection and test.

G. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.

H. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without system or equipment malfunctions.

1. Record system operations and malfunctions.
2. If malfunction occurs, start diagnostic period over after correction of malfunction.
3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.09 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:

1. Hands-On Instruction: On-site, using operational system.

B. Administrative: One-hour session(s) covering issues necessary for nontechnical administrative staff; classroom:

1. Initial Training: One session precloseout.

C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:

1. Initial Training: One session precloseout.

D. Use operation and maintenance documentation as primary instruction material; have paper copies available for attendees and supplement training material aids.

3.10 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals for additional submittals.

B. See Section 01 7900 - Demonstration and Training for additional requirements.

C. Closeout Demonstration: Demonstrate operation of all functions to Owner.

1. Be prepared to conduct any of required tests.
2. Have minimum one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
3. Have authorized technical representative of FACU manufacturer present during demonstration.

4. Demonstration may be combined with inspection and testing required by AHJ; notify AHJ with enough time to schedule demonstration.
5. Repeat demonstration until successful.

D. Occupancy will not occur prior to Substantial Completion.

E. Substantial Completion of project cannot be achieved until inspection and testing is successful and the following:

1. Specified diagnostic period without malfunction has been completed.
2. Approved operating and maintenance data has been delivered.
3. Spare parts, extra materials, and tools have been delivered.
4. All aspects of operation have been demonstrated to Owner.
5. Final acceptance of fire alarm system has been given by AHJ.
6. Occupancy permit has been granted.
7. Specified precloseout instruction is complete.

3.11 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements relating to maintenance service.

B. Provide to Owner, at no extra cost, written maintenance contract for entire manufacturer's warranty period, to include work described below.

C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:

1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
2. Repairs required, unless due to improper use, accidents, or negligence beyond control of maintenance contractor.
3. Record keeping required by NFPA 72 and AHJ.

D. Provide trouble call-back service upon notification by Owner:

1. Provide on-site response within two hours of notification.
2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
3. Owner will pay for call-back service outside of normal working hours on hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

E. Provide complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with detailed schedule.

F. Maintain on-site log listing date and time of each inspection and call-back visit, condition of system, nature of trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

G. Comply with Owner's requirements for access to facility and security.

END OF SECTION 28 4600

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures
B. Section 01 45 00 – Quality Control
C. Section 31 05 16 – Aggregates for Earthwork
D. Section 31 05 19 – Geotextiles
E. Section 31 20 00 – Earth Moving
F. Section 31 23 00 – Excavation and Fill
G. Section 31 23 16 – Excavation and Backfill for Utilities
H. Section 31 25 00 – Erosion and Sedimentation Controls
I. Section 32 13 13 – Concrete Paving
J. Section 32 90 00 – Planting

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)
    1. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
    2. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
    3. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
    4. ASTM D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
    5. ASTM D4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
    6. ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
    7. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3)
    8. ASTM D4829 – Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
    9. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
B. American Association of State Highway and Transportation Officials (AASHTO)
    1. AASHTO T99 – Moisture-Density Relations of Soils Using a 5.5-lb Rammer and 12-in. Drop
    2. AASHTO T180 – Moisture-Density Relations of Soils Using a 10-lb Rammer and 18-in. Drop
C. International Building Code (IBC) 2021
D. Occupational Safety and Health Administration (OSHA) Standards 29 CFR

E. Local Jurisdictional Codes and Regulations (as applicable)

1.3 DEFINITIONS

A. 1.3.1 Earthwork: All excavation, filling, backfilling, and grading operations required to prepare the site for construction.
B. 1.3.2 Compaction: The process of increasing soil density by mechanical means to achieve specified soil properties.
C. 1.3.3 Borrow Soil: Soil imported from off-site for use as fill.
D. 1.3.4 Subgrade: The prepared surface on which subsequent construction or fill is placed.

1.4 SUBMITTALS

A. Action Submittals
    1. Soil Reports including geotechnical investigation and analysis.
    2. Proposed excavation and earthwork plan with sequencing and equipment.
    3. Sources and specifications of imported fill materials including gradation and compaction characteristics.
    4. Compaction test plan and quality control procedures.
    5. Proposed erosion and sediment control plan related to earthwork operations.
    6. List of equipment to be used in earthwork operations.
B. Informational Submittals
    1. Copies of permits and approvals related to earthwork.
    2. Material test reports for fill materials.
    3. Daily earthwork logs indicating volume of excavation/fill and compaction results.
    4. Certification of compliance for compaction and moisture content.
    5. Safety plan specific to excavation and earthwork activities.
    6. Records of field density tests and laboratory testing results.

1.5 QUALITY ASSURANCE

A. Qualifications
    1. Engage a qualified geotechnical engineer to review soil conditions, perform testing, and provide recommendations.
    2. Employ experienced personnel and licensed contractors specializing in earthwork operations.
B. Testing
    1. Perform soil classification, moisture content, and compaction testing per ASTM and AASHTO standards.
    2. Testing laboratory shall be accredited and independent from the contractor.
    3. Field density tests shall be conducted at a frequency not less than one test per 500 square feet per lift or as required by governing codes.

C. Verification
    1. Verify excavation limits, subgrade elevations, and compaction levels prior to placement of fill or construction.
    2. Perform pre-construction survey and documentation of existing site conditions.
D. Safety
    1. Earthwork shall comply with OSHA requirements for excavation safety, including shoring, sloping, and protective systems.
    2. Provide barricades, signage, and protective measures to secure excavation areas.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery
    1. Deliver fill materials in a dry, uncompacted condition and free from debris, organic matter, and frozen materials.
B. Storage
    1. Stockpile imported and on-site soils separately to prevent mixing of unsuitable materials.
    2. Protect stockpiles from contamination and erosion by wind or rain.
C. Handling
    1. Handle materials to prevent segregation or contamination.
    2. Maintain moisture content within specified limits during handling and placement to ensure compaction quality.

1.7 WARRANTY

A. Provide a warranty for earthwork materials and workmanship against defects for a period of one year from date of substantial completion.
B. Warranty shall cover settlement, inadequate compaction, erosion, or failure of earthwork to perform as specified.
C. Contractor shall promptly repair or replace defective work at no additional cost to the Owner.

PART 2 – PRODUCTS

2.1 SOILS AND FILL MATERIALS

A. General Requirements
    1. Fill material shall be free from organic matter, roots, debris, frozen soil, and other deleterious materials.
    2. Material shall meet gradation requirements per ASTM D2487 Soil Classification System as specified in project documents.
B. On-Site Soils

1. On-site soils may be used if tested and approved by the geotechnical engineer.

C. Imported Fill
    1. Imported fill shall comply with project specifications and be approved prior to delivery.
    2. Gradation, plasticity, and compaction characteristics shall be provided by supplier.

2.2 GEOTEXTILES AND EROSION CONTROL MATERIALS

A. Geotextiles shall conform to Section 31 05 19 and be used where indicated to separate fill materials or stabilize subgrade.
B. Erosion control blankets and sediment barriers shall comply with Section 31 25 00.

2.3 MANUFACTURERS

A. 2Soil Suppliers
    1. ABC Earth Materials Inc.
    2. XYZ Aggregate Supply Company
    3. National Fill Material Providers
B. Geotextile and Erosion Control
    1. TenCate Geosynthetics
    2. Propex Operating Company LLC
    3. Huesker, Inc.
C. Testing Laboratories
    1. SoilTech Laboratories
    2. GeoTest Engineering Services
    3. National Materials Testing, Inc.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are ready to receive work and that underground utilities and structures are located and protected.
B. Notify Engineer of any discrepancies or unsuitable conditions before proceeding.
C. Verify that subgrade is free of frost, standing water, soft spots, debris, and frozen materials.

3.2 PREPARATION

A. Clearing and Grubbing
    1. Remove trees, shrubs, roots, debris, and topsoil as indicated.

B. Stripping and Stockpiling
    1. Strip topsoil from areas to be excavated or filled and stockpile separately.
C. Excavation
    1. Excavate to subgrade elevations as indicated.
    2. Remove unsuitable or unstable soils as directed.
D. Subgrade Preparation
    1. Scarify and loosen subgrade surface where required to achieve bonding with fill.
    2. Moisture condition subgrade to optimum moisture content for compaction.

3.3 FILL PLACEMENT AND COMPACTION

A. Placement
    1. Place fill in horizontal lifts not exceeding 8 inches loose thickness unless otherwise approved.
    2. Maintain moisture content within plus or minus 2% of optimum moisture content.
B. Compaction
    1. Compact each lift to not less than 95 percent of maximum dry density as determined by ASTM D698 or D1557.
    2. Use appropriate compaction equipment such as rollers, rammers, or vibratory compactors.
C. Testing
    1. Perform field density tests at required frequencies.
    2. Provide results to Engineer for acceptance.
D. Correction of Deficiencies
    1. Remove or rework areas failing to meet compaction or moisture requirements.
    2. Retest after corrective action until specified requirements are met.

3.4 GRADING

A. Uniformly grade and shape earthwork areas to required elevations and slopes.
B. Provide positive drainage away from structures and as indicated on drawings.
C. Finish surfaces smooth and free of irregularities.

3.5 EROSION AND SEDIMENTATION CONTROL

A. Implement erosion control measures during and after earthwork to prevent sediment runoff.
B. Maintain temporary erosion control devices until permanent stabilization is established.

3.6 FIELD QUALITY CONTROL

A. Inspection and Testing

1. Engineer or testing agency will perform periodic inspections and testing.
2. Contractor shall cooperate and provide access and documentation.

B. Non-Conformance
1. Immediately correct non-conforming work.
2. Additional testing and inspection may be required at Contractor's expense.

3.7 PROTECTION

A. Protect completed earthwork from disturbance or damage by subsequent construction activities.
B. Repair or rework any damaged areas to meet original specifications.

3.8 CLEANING

A. Remove surplus materials, debris, and equipment from site.
B. Leave site in a clean and orderly condition.

END OF SECTION

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.

1.1 SUMMARY

A. This Section includes the following:
   1. Clearing and grubbing of vegetation and debris.
   2. Removal and disposal of trees, shrubs, roots, stumps, brush, and other vegetation.
   3. Stripping and stockpiling topsoil.
   4. Removal and disposal of existing improvements and debris as indicated.
   5. Site dewatering and sediment control as required during clearing operations.

B. Related Sections include, but are not limited to:
   1. Division 31 Section "Earth Moving" for excavation, backfilling, and grading.
   2. Division 31 Section "Erosion and Sedimentation Controls" for soil erosion prevention and sediment control.
   3. Division 32 Section "Landscape Grading" for final grading and landscape preparation.
   4. Division 32 Section "Soil Preparation" for soil amendments and preparation.
   5. Division 01 Section "Temporary Facilities and Controls" for temporary erosion and sedimentation control measures.

1.2 REFERENCES, CODES, AND STANDARDS

A. Applicable codes and standards include but are not limited to:
   1. American National Standards Institute (ANSI) Z133.1 - American National Standard for Arboricultural Operations – Safety Requirements.
   2. Occupational Safety and Health Administration (OSHA) Standards, 29 CFR Part 1926 - Safety and Health Regulations for Construction.
   3. ASTM International:
      a) ASTM D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
      b) ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
      c) ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   4. U.S. Environmental Protection Agency (EPA) - Clean Water Act (CWA) for sediment control and stormwater management.
   5. Local and State Environmental Protection Regulations.

6. International Society of Arboriculture (ISA) Best Management Practices for Tree Removal and Protection.
7. National Fire Protection Association (NFPA) 241 - Standard for Safeguarding Construction, Alteration and Demolition Operations.

1.3 SUBMITTALS

A. Action Submittals:
   1. Site Clearing Plan indicating limits of clearing, protection zones for existing trees to be preserved, stockpile locations, and sediment control measures.
   2. Equipment List including types and capacity of equipment proposed for clearing operations.
   3. Schedule of Clearing Activities including sequence and timing.
   4. Waste Management Plan detailing disposal methods and recycling of cleared materials.
   5. Certification of Compliance with applicable codes and standards.
   6. Proposed Methods for Removal of Hazardous Vegetation or Material, if applicable.
B. Informational Submittals:
   1. Copies of permits and notifications required for clearing operations.
   2. Manufacturer's product data for erosion control products used during clearing.
   3. Photographic documentation of site conditions before and after clearing.
   4. Material Safety Data Sheets (MSDS) for chemicals or herbicides used, if any.

1.4 QUALITY ASSURANCE

A. Perform site clearing work in accordance with recognized industry standards and manufacturers' recommendations.
B. Personnel performing tree removal or trimming shall be certified arborists or experienced operators familiar with ANSI Z133.1 safety requirements.
C. Maintain erosion and sediment controls at all times during clearing activities to prevent sedimentation of adjacent properties and water bodies.
D. Comply with all local, state, and federal environmental regulations regarding protected species, wetlands, and historic resources.
E. Pre-clearing meeting to be conducted with Owner, Contractor, and appropriate authorities to review clearing limits, protection measures, and safety protocols.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store erosion control materials, such as silt fencing, wattles, and blankets, in a dry, protected area to prevent damage and contamination.
B. Handle cleared materials to prevent spillage and facilitate recycling or disposal.

C. Maintain equipment in good working order and free of oil, fuel, or other contaminants that could cause environmental damage.
D. Protect stockpiled topsoil from erosion, contamination, and compaction. Cover stockpiles when not actively used.

1.6 WARRANTY

A. Provide warranty for clearing operations that all work will be free of defects in workmanship and materials for a period of one year from date of final acceptance.
B. Warranty includes responsibility for repair or replacement of any damage to adjacent protected trees, utilities, or improvements caused by clearing operations.
C. Warranty includes ensuring that no undesirable vegetation or debris remains that could affect subsequent construction or landscaping.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Erosion and Sediment Control Products:
    1. North American Green
    2. Profile Products LLC
    3. Best Management Products, Inc.
    4. Silt-Saver, Inc.
B. Tree Protection Materials:
    1. Greenleaf Nursery Company
    2. Arborwear, Inc.
C. Equipment Manufacturers (examples):
    1. Caterpillar Inc.
    2. John Deere
    3. Komatsu America Corp.

2.2 MATERIALS

A. Erosion Control Materials: Silt fences, wattles, erosion control blankets, mulch, and soil stabilization products as specified in Division 31 Sections.
B. Topsoil: Stockpiled native topsoil free of roots, debris, and contaminants.
C. Disposal Containers: Containers and receptacles for collection and transport of cleared materials.
D. Herbicides or Chemicals: Use only if specified and approved, and in accordance with applicable regulations and MSDS.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that utility locations have been identified and marked. Notify utility companies and the Owner of conflicts prior to clearing.
B. Confirm limits of clearing and grubbing with the Owner's representative.
C. Identify trees, vegetation, or site features to be preserved or protected.
D. Inspect erosion and sediment control measures to ensure they are installed and functioning before clearing begins.

3.2 PREPARATION

A. Install sediment and erosion control devices around the perimeter of the clearing area and at appropriate points downslope.
B. Mark and protect trees and vegetation to remain using fencing or barricades.
C. Conduct a pre-clearing meeting with all personnel involved to review safety, environmental protection, and clearing procedures.

3.3 CLEARING AND GRUBBING

A. Remove all trees, shrubs, brush, roots, stumps, and other vegetation within the designated clearing limits.
B. Remove above and below ground parts of vegetation including roots and stumps to a minimum depth of 18 inches below finished grade or as otherwise indicated.
C. Remove man-made improvements, debris, rubbish, and other obstructions encountered within the clearing limits.
D. Dispose of cleared materials off-site or process for reuse or recycling in accordance with the Waste Management Plan.
E. Topsoil stripping: Strip, stockpile, and protect topsoil from erosion and contamination for reuse in landscaping or site restoration.
F. Minimize disturbance to soils outside designated clearing limits.

3.4 TREE PROTECTION

A. Maintain protective fencing and barriers around trees and vegetation to remain throughout construction.
B. Prohibit parking, storage of materials, and heavy equipment traffic within tree protection zones.
C. Repair damage to roots, trunks, or branches caused during clearing operations in accordance with ISA Best Management Practices.

3.5 EROSION AND SEDIMENT CONTROLS

A. Maintain and monitor erosion control devices continuously during clearing operations.

B. Repair or replace damaged or ineffective controls immediately.
C. Remove sediment accumulations from control devices before capacity is exceeded.
D. Restore disturbed areas promptly to minimize erosion.

3.6 FIELD QUALITY CONTROL

A. Conduct inspections at the start and completion of clearing operations.
B. Verify that clearing limits are adhered to and protective measures are effective.
C. Document and report any damage to protected trees, utilities, or structures.
D. Confirm proper disposal of debris and cleared materials.

3.7 CLEANING

A. Remove all debris, rubbish, and waste materials from site clearing activities daily or as needed to maintain safe and orderly conditions.
B. Restore areas outside clearing limits disturbed by clearing operations to original or better condition.

3.8 PROTECTION

A. Protect newly cleared and stripped areas from unauthorized access and damage.
B. Maintain erosion and sediment controls in good condition until final site stabilization is achieved.
C. Protect adjacent properties from damage or encroachment.

3.9 COMPLETION

A. Notify the Owner upon completion of clearing activities for inspection and acceptance.
B. Provide documentation of completed clearing, including photographic evidence and waste disposal records.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Section 31 11 00 – Site Clearing
B. Section 31 23 00 – Excavation and Fill
C. Section 31 23 16 – Dewatering
D. Section 31 25 00 – Erosion and Sediment Control
E. Section 32 91 00 – Planting
F. Section 01 33 00 – Submittal Procedures
G. Section 01 45 00 – Quality Control
H. Section 01 74 19 – Construction Waste Management and Disposal

1.2 REFERENCES, CODES, AND STANDARDS

A. American National Standards Institute (ANSI)
    1. ANSI Z133.1 – American National Standard for Arboricultural Operations – Safety Requirements
B. American Society for Testing and Materials (ASTM)
    1. ASTM D6274 – Standard Guide for Tree Preservation During Construction
    2. International Code Council (ICC)
    3. International Building Code (IBC), latest edition
    4. Occupational Safety and Health Administration (OSHA)
    5. OSHA 29 CFR 1926 – Safety and Health Regulations for Construction
    6. Society of American Foresters (SAF)
    7. SAF Best Management Practices for Forestry
    8. U.S. Department of Agriculture (USDA)
    9. USDA Urban Forestry Best Management Practices
    10. Local municipal and state regulations regarding tree protection and clearing operations

1.3 DEFINITIONS

A. Selective Clearing: Removal of designated vegetation including trees, shrubs, and undergrowth according to project limits and plans, preserving specified vegetation and natural features.
B. Protected Tree: Trees identified for preservation on project drawings or by the Owner/Architect.
C. Clearing Limits: Boundaries established to define areas of selective clearing and protect remaining vegetation.

1.4 SUBMITTALS

A. Action Submittals
    1. Clearing Plan indicating limits of clearing, protected trees, and tree protection measures.
    2. Schedule of selective clearing operations.
    3. List of equipment to be used for clearing.
    4. Material Safety Data Sheets (MSDS) for herbicides or chemical agents if applicable.
    5. Tree Protection Plan prepared by a qualified arborist if required.
    6. Proposed erosion and sediment control measures related to clearing activities.
B. Informational Submittals
    1. Qualifications of personnel performing selective clearing.
    2. Manufacturer's literature for tree protection materials and equipment.
    3. Photographic documentation of existing site conditions before clearing.
    4. Waste management plan for clearing debris including disposal or recycling methods.

1.5 QUALITY ASSURANCE

A. Perform selective clearing in accordance with ANSI Z133.1 safety standards and OSHA regulations.
B. Engage personnel experienced in selective clearing and preservation techniques.
C. Utilize qualified arborists for tree protection supervision and consultation.
D. Verify clearing limits and protection measures in coordination with the Owner/Architect prior to commencement.
E. Conduct pre-clearing site meeting to review limits, protection procedures, and safety requirements.
F. Protect remaining vegetation in accordance with ASTM D6274 and USDA Urban Forestry Best Management Practices.
G. Implement erosion and sediment control measures compliant with Section 31 25 00 and local environmental regulations.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials such as tree protection fencing, signage, and erosion control devices in original packaging with labels intact.
B. Store materials on-site in designated areas protected from damage, moisture, and contamination.
C. Protect stored materials from weather and construction traffic.
D. Handle all clearing equipment and materials to prevent damage to protected vegetation and site features.
E. Maintain access for emergency vehicles and personnel during clearing operations.

1.7 WARRANTY

A. Provide warranty for selective clearing work, including protection of preserved vegetation, for a minimum period of one year from date of Substantial Completion.
B. Warranty shall cover replacement or remediation of damage to protected trees and vegetation caused by clearing operations or failure to implement protection measures.
C. Provide manufacturer's warranties for tree protection materials and equipment as applicable.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Tree Protection Fencing and Barriers
    1. Orange Safety Fence by Tenax Corporation
    2. Tree Save Products by Dewitt Company
    3. Chain Link Temporary Fencing by Master Halco
B. Tree Protection Materials
    1. Burlap Wraps by Green-Tek Inc.
    2. Tree Trunk Guards by Tree Tech LLC
C. Erosion and Sediment Control Products
    1. Silt Fence by Filtrexx International
    2. Straw Wattles by North American Green
D. Herbicides and Chemical Agents (if applicable)
    1. Rodeo Herbicide by Dow AgroSciences
    2. Garlon Herbicide by Dow AgroSciences
E. Clearing Equipment
    1. Hydraulic Excavators by Caterpillar Inc.
    2. Brush Chippers by Vermeer Corporation
    3. Chainsaws by Stihl Inc.

2.2 MATERIALS

A. Tree Protection Fencing
    1. High-visibility plastic mesh fencing, minimum 4 feet high, orange or equivalent color.
B. Tree Protection Signs
    1. Weather-resistant signage indicating "Tree Protection Zone – Keep Out" or similar.
C. Trunk and Root Protection
    1. Burlap or approved tree wraps to protect trunks during clearing operations.
    2. Mulch or wood chips for root zone protection where required.
D. Erosion Control

1. Silt fencing and straw wattles meeting local environmental standards.

E. Herbicides
    1. Only approved herbicides applied by licensed applicators in accordance with manufacturer's instructions and local regulations.

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify clearing limits and protected vegetation locations as per contract documents and site markings.
B. Install tree protection fencing and signage around protected trees and vegetation prior to clearing operations.
C. Conduct pre-clearing meeting with site personnel, arborist, and Owner's representative to review protection measures and safety protocols.
D. Coordinate with utilities to locate and protect underground and overhead services.
E. Implement erosion and sediment control measures before clearing begins.

3.2 SELECTIVE CLEARING PROCEDURES

A. Remove only vegetation indicated for clearing on plans. Preserve designated trees, shrubs, and ground cover.
B. Cut trees and shrubs cleanly at ground level or as otherwise indicated. Remove stumps only if specified.
C. Use equipment and methods that minimize soil disturbance and damage to adjacent vegetation.
D. Avoid operation of heavy equipment within root protection zones of preserved trees.
E. Dispose of cleared vegetation promptly according to waste management plan. Recycle or reuse materials where possible.
F. Apply herbicides only if approved and in accordance with manufacturer instructions and environmental regulations.

3.3 PROTECTION OF VEGETATION

A. Maintain tree protection fencing and signage throughout clearing operations. Repair or replace damaged fencing immediately.
B. Protect root zones of preserved trees by limiting soil compaction and disturbance. Use mulch or protective mats if equipment must pass near roots.
C. Protect trunks with wraps or guards if mechanical injury is possible.
D. Monitor health of preserved trees during and after clearing; notify Owner if damage occurs.

3.4 SITE RESTORATION

A. Remove tree protection fencing and signage after clearing is complete and site is stabilized.
B. Restore disturbed areas outside clearing limits as specified in related planting and site work sections.
C. Dispose of all debris, including stumps and roots, in accordance with local regulations.
D. Final grade clearing limits to prevent erosion and promote drainage.

3.5 CLEANING

A. Remove all equipment, materials, and debris from the site at completion of clearing.
B. Leave the site in a clean, safe, and orderly condition.

3.6 FIELD QUALITY CONTROL

A. Arborist to inspect tree protection installations and clearing operations periodically.
B. Correct any deficiencies related to tree protection or clearing methods immediately.
C. Document inspections and corrective actions for Owner's records.

3.7 PROTECTION

A. Protect site and adjacent properties from damage caused by clearing operations.
B. Prevent unauthorized access to clearing areas with fencing and signage.
C. Comply with all safety regulations including OSHA during clearing operations.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes
B. Stripping and removal of topsoil, vegetation, and unsuitable materials from designated areas.
C. Excavation, handling, and stockpiling of earth materials for reuse or disposal.
D. Protection and maintenance of stockpiled materials.
    1. Related Sections
    2. Section 31 00 00 – Earthwork
        a) Section 31 23 00 – Excavation and Fill
        b) Section 31 25 00 – Erosion and Sedimentation Controls
        c) Section 31 20 00 – Earth Moving
        d) Section 31 22 00 – Grading
        e) Section 32 91 00 – Planting Soil and Soil Amendments
        f) Section 01 35 29 – Health and Safety Procedures
        g) Section 01 33 00 – Submittal Procedures
    3. Definitions
        a) Earth Stripping: Removal of topsoil, vegetation, and unsuitable materials from the site surface.
        b) Stockpiling: Temporary storage of stripped earth materials for reuse or disposal.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)
B. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
C. ASTM D422 – Particle-Size Analysis of Soils
D. ASTM D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3)
E. ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils
F. ASTM D1556 – Density and Unit Weight of Soil in Place by the Sand-Cone Method
G. Occupational Safety and Health Administration (OSHA) Standards
H. OSHA 29 CFR 1926 – Safety and Health Regulations for Construction
I. U.S. Environmental Protection Agency (EPA)
J. EPA SW-846 – Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
K. American National Standards Institute (ANSI)
L. ANSI A10.9 – Safety Requirements for Excavation Work
M. International Code Council (ICC)
N. International Building Code (IBC) 2021 Edition

O. Local and State Regulations
P. Comply with all applicable local and state environmental, safety, and construction codes and regulations.

1.3 SUBMITTALS

A. Action Submittals
    1. Product Data: Include manufacturer's information on equipment used for stripping and stockpiling.
    2. Construction Schedule: Indicate timing and sequence of stripping and stockpiling operations.
    3. Method Statement: Detailed description of procedures for stripping, excavation, stockpiling, and protection of materials.
    4. Equipment List: Identification of equipment intended for use.
    5. Quality Control Plan: Procedures for soil classification, testing, and verification of material suitability.
    6. Erosion and Sediment Control Plan: Include measures to prevent erosion and sedimentation during stripping and stockpiling.
B. Informational Submittals
    1. Soil Test Reports: Results of soil classification, contamination, and suitability analyses.
    2. Material Source Documentation: Documentation identifying sources of imported soils if used.
    3. Safety Plan: Health and safety procedures related to earth stripping and stockpiling operations.
    4. Environmental Protection Measures: Documentation of compliance with environmental permits and regulations.
    5. Photographic Documentation: Pre-stripping and post-stripping site conditions.

1.4 QUALITY ASSURANCE

A. Qualifications
    1. Perform work by experienced personnel skilled in earth stripping and stockpiling operations.
    2. Contractor shall employ a qualified geotechnical engineer or soil specialist to oversee testing and classification.
B. Testing and Inspection
    1. Soil samples shall be tested in accordance with ASTM standards referenced in 1.2.
    2. Verify soil moisture content and compaction characteristics to ensure suitability for reuse or disposal.
    3. Inspections shall be conducted to verify compliance with project requirements and environmental regulations.

C. Environmental Compliance
    1. Comply with all erosion and sedimentation control requirements during stripping and stockpiling.
    2. Maintain dust control measures to minimize airborne particulates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery
    1. Coordinate delivery of equipment and materials to minimize site congestion and disruption.
B. Storage
    1. Stockpile stripped materials in designated areas as indicated on project drawings.
    2. Protect stockpiles from contamination, erosion, and excessive moisture.
    3. Maintain stockpile geometry to prevent instability and ensure ease of access.
C. Handling
    1. Handle materials to prevent mixing of unsuitable materials with approved soils.
    2. Prevent compaction or degradation of stockpiled materials by restricting heavy equipment movement over stockpiles.

1.6 WARRANTIES

A. Provide warranty that stripped and stockpiled materials are free from contamination and meet project specifications for reuse.
B. Warranty period shall be minimum one year from date of substantial completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Equipment Manufacturers (examples)
    1. Caterpillar Inc.
    2. John Deere
    3. Komatsu Ltd.
    4. Volvo Construction Equipment
    5. Hitachi Construction Machinery
B. Material Suppliers
    1. Local soil suppliers approved by project geotechnical engineer.
    2. Suppliers of erosion control materials and soil amendments as specified in related sections.

2.2 MATERIALS

A. Stripped Topsoil

1. Free of roots, debris, stones over 2 inches in diameter, and other deleterious materials.
2. Suitable for reuse in landscaping, planting, or site restoration.

B. Subsoil and Other Earth Materials
   1. Classified and tested according to ASTM D2487 and project geotechnical requirements.
   2. Free of organic matter and unsuitable contaminants.

C. Erosion Control Materials
   a) Mulch, geotextiles, silt fences, and other materials conforming to Section 31 25 00.

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify site boundaries and stripping limits with project surveyor.
B. Identify and mark protected areas and utilities prior to stripping.
C. Install erosion and sediment control measures as required before beginning stripping operations.
D. Conduct pre-stripping photographic documentation of existing site conditions.

3.2 EARTH STRIPPING

A. Remove topsoil, vegetation, and unsuitable materials to depths and limits indicated on drawings or as directed by Engineer.
B. Strip materials in a manner to prevent mixing of unsuitable soils with topsoil or stockpile materials.
C. Do not strip when soils are frozen or excessively wet to avoid damage and contamination.
D. Transport stripped materials promptly to designated stockpile areas.
E. Maintain safe slopes and access routes during stripping operations.

3.3 STOCKPILING

A. Locate stockpiles in designated areas with stable subgrade and adequate drainage.
B. Construct stockpiles to a height not exceeding 10 feet unless otherwise approved.
C. Shape stockpiles to promote drainage and minimize erosion.
D. Protect stockpiles from contamination by debris, waste, or construction materials.
E. Cover or stabilize stockpiles as required to control dust and erosion.
F. Restrict equipment movement on stockpiles to prevent compaction and degradation.
G. Maintain records of stockpile volumes, locations, and material characteristics.

3.4 TESTING AND ACCEPTANCE

A. Sample stockpiled materials for classification and suitability testing in accordance with ASTM standards.
B. Reject materials contaminated or unsuitable for reuse; remove from site or dispose of according to regulations.
C. Engineer will perform periodic inspections of stripping and stockpiling operations to verify compliance.

3.5 CLEANUP

A. Remove debris, unsuitable materials, and equipment from site upon completion of stripping and stockpiling.
B. Restore disturbed areas outside stripping limits as directed.

3.6 PROTECTION

A. Protect stripped and stockpiled materials from erosion, contamination, and compaction until reused or removed.
B. Maintain erosion and sediment control devices during stockpiling phase.
C. Monitor stockpiles regularly for signs of instability or environmental impact and take corrective action as necessary.

END OF SECTION

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, but are not limited to:
    1. 31 23 00 - Excavation and Fill
    2. 31 23 16 - Excavation and Backfill for Utilities
    3. 31 25 00 - Erosion and Sedimentation Controls
    4. 32 91 00 - Planting Soil Preparation
    5. 31 05 19 - Geotechnical Exploration Reports
    6. 01 33 00 - Submittal Procedures
    7. 01 35 43 - Environmental Compliance
    8. 01 74 19 - Construction Waste Management and Disposal

1.2 SUMMARY

A. This Section includes site grading including cutting, filling, leveling, and contouring for building pads, utilities, roadways, sidewalks, and landscaped areas.
B. Related work specified elsewhere includes:
    1. Excavation and fill for utilities in Section 31 23 16.
    2. Erosion and sediment control in Section 31 25 00.
    3. Soil preparation and amendments in Section 32 91 00.

1.3 DEFINITIONS

A. Grading: The process of reshaping the ground surface by cutting, filling, or leveling to the required lines, elevations, and slopes.
B. Finish Grade: The final elevation and slope of the ground surface after grading is complete.
C. Rough Grade: The initial shaping of the site prior to finish grading.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

A. Action Submittals:
    1. Grading Plan: Detailed plan indicating existing and proposed grades, contours, drainage patterns, and locations of cuts and fills.
    2. Soil Reports: Geotechnical reports including recommendations for grading, compaction, and fill materials.
    3. Equipment List: List of equipment proposed for grading operations.
    4. Mix Designs: For any engineered fill or soil stabilization materials.

5. Erosion and Sediment Control Plan demonstrating compliance with applicable environmental regulations.

B. Informational Submittals:
    1. Field Quality Control Reports including compaction test results.
    2. Material Certificates for fill materials.
    3. Manufacturer's product data for any soil stabilization or erosion control products used.

1.5 QUALITY ASSURANCE

A. Perform grading in accordance with accepted industry standards including ASTM and local building codes.
B. Compaction Testing:
    1. Engage an independent testing agency to perform field density tests at frequencies required by the geotechnical engineer and local authorities.
    2. Tests shall comply with ASTM D1556, ASTM D698, ASTM D2922, or ASTM D6938 as applicable.
C. Personnel Qualifications:
    1. Contractor shall employ personnel with minimum 5 years' experience in site grading and earthwork operations.
    2. Operator certification for heavy equipment shall be current and verifiable.
D. Compliance with Codes and Standards:
    1. Comply with applicable federal, state, and local regulations including OSHA safety standards related to earthwork operations.
    2. Comply with stormwater management and erosion control requirements as per EPA and local jurisdictional authorities.
E. Mock-Up:
    1. When requested by the Architect/Engineer, provide a mock-up area to demonstrate grading techniques and finish quality.

1.6 STORAGE AND HANDLING

A. Store fill materials in designated areas protected from contamination, erosion, and loss by wind or water.
B. Protect excavated materials from moisture changes and contamination.
C. Handle all materials to prevent segregation, contamination, or damage.
D. Equipment used for grading shall be maintained in good working condition to prevent leaks or spills of fuel, oil, or hydraulic fluids.
E. Store erosion control materials and equipment on-site in dry, accessible locations.

1.7 WARRANTY

A. Provide a warranty for grading work that guarantees the work will remain stable and free from erosion, settling, or other defects for a minimum period of one year from date of final acceptance.
B. Warranty shall include repair or replacement of any areas showing failure or nonconformance to specified grades.
C. Provide manufacturer warranties for soil stabilization or erosion control products as applicable.

1.8 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. Codes:
    1. International Building Code (IBC), latest edition.
    2. Occupational Safety and Health Administration (OSHA) Standards, 29 CFR Part 1926 – Construction.
    3. Local Building and Zoning Codes.
    4. Clean Water Act, Section 402 NPDES Stormwater Program.
B. Standards:
    1. ASTM International:
        a) ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
        b) ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
        c) ASTM D2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
        d) ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Depth Moisture Gauge).
        e) ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
        f) ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
    2. USDA Natural Resources Conservation Service (NRCS) Soil Survey and Classification Guidelines.
C. References:
    1. “Earthwork and Grading Handbook,” Nick Capachi, McGraw Hill, latest edition.
    2. “Site Engineering for Landscape Architects,” Steven Strom, Kurt Nathan, Jake Woland.
    3. Local Geotechnical Engineering Reports.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Fill Material:
    1. Shall be free of organic matter, debris, frozen material, trash, and other deleterious substances.
    2. Shall meet gradation and compaction requirements as specified in the geotechnical report or as approved by the Engineer.
    3. Shall have plasticity index and liquid limit within acceptable ranges to ensure stability and compaction.
B. Topsoil:
    1. Shall be fertile, friable natural loam free of subsoil, clay lumps, stones over 1 inch, roots, sticks, and other foreign matter.
    2. Shall meet requirements specified in Section 32 91 00.
C. Soil Stabilization Products (if applicable):
    1. Chemical stabilizers, geotextiles, or other additives shall be compatible with site conditions and meet manufacturer's recommendations.
    2. Shall comply with environmental regulations.
D. Erosion Control Materials:
    1. Mulches, mats, blankets, and other devices shall conform to Section 31 25 00.
E. Water:
    1. Potable water free of impurities harmful to soil stabilization or vegetation.

2.2 EQUIPMENT

A. Use heavy equipment suitable for grading operations including but not limited to bulldozers, graders, scrapers, compactors, and water trucks.
B. Equipment shall be maintained in good working order and free of leaks.

2.3 MANUFACTURERS

A. 2.3.1 Soil Stabilizers and Additives:
    1. TerraSystems, Inc.
    2. Soilworks, LLC
    3. BASF Corporation
    4. Sika Corporation
B. 2.3.2 Erosion Control Products:
    1. North American Green
    2. Profile Products LLC
    3. Western Excelsior
C. 2.3.3 Testing and Compaction Equipment:
    1. Troxler Electronic Laboratories
    2. Humboldt Mfg. Co.
D. 2.3.4 Heavy Equipment:
    1. Caterpillar Inc.
    2. John Deere

3. Komatsu America Corp.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that existing site conditions, including grades, drainage patterns, and utilities, conform to requirements.
B. Review geotechnical reports and recommendations.
C. Notify Architect/Engineer of any discrepancies or conditions detrimental to proper execution of grading.
D. Do not proceed with grading until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect existing structures, utilities, vegetation, and improvements designated to remain.
B. Remove debris, vegetation, and unsuitable materials from areas to be graded.
C. Establish erosion and sediment control measures prior to grading operations.
D. Identify and mark limits of grading and stockpile locations.

3.3 GRADING

A. General Requirements:
    1. Perform grading to lines, elevations, and slopes indicated on the Drawings.
    2. Maintain grades to ensure positive drainage away from structures and utilities.
    3. Avoid over-excavation; fill and compact as required to achieve design elevations.
    4. Do not place fill or compact when moisture content is unsuitable.
B. Rough Grading:
    1. Cut and fill to approximate grades to facilitate drainage and installation of utilities.
    2. Scarify subgrade where required to enhance bonding of fill material.
C. 3.3.3 Fill Placement and Compaction:
    1. Place fill in layers not exceeding 8 inches loose thickness.
    2. Compact each layer to minimum 95% of maximum dry density as determined by ASTM D698 or as specified by the geotechnical engineer.
    3. Moisture content of fill material shall be maintained within +/- 2% of optimum moisture content.
D. 3.3.4 Finish Grading:
    1. Fine grade areas to final elevations and slopes, providing smooth and even surfaces.
    2. Remove irregularities, depressions, or humps.
E. 3.3.5 Tolerances:
    1. Finish grade elevations shall be within +/- 0.05 feet of indicated elevations.

2. Slopes shall be within 2 percent of specified gradients.

3.4 FIELD QUALITY CONTROL

A. Compaction Testing:
    1. Perform density tests at locations and frequency as required by the geotechnical engineer and governing authorities.
    2. Provide copies of test reports to Architect/Engineer promptly.
    3. Areas failing to meet compaction requirements shall be reworked and retested.
B. Observation and Verification:
    1. Testing agency shall observe fill placement, moisture conditioning, and compaction operations.
C. Correct deficiencies immediately upon discovery.

3.5 PROTECTION

A. Protect finished grading from traffic, erosion, and weather damage until subsequent construction or landscaping.
B. Repair settlement, erosion, or other damage to finished grading at no cost to Owner.
C. Maintain erosion and sediment controls until permanent vegetation or other stabilization measures are established.

3.6 CLEANING

A. Remove surplus materials, debris, and equipment from site.
B. Leave site clean and ready for subsequent construction activities.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Section 31 20 00 - Earth Moving
B. Section 31 05 16 - Geotextiles
C. Section 31 00 00 - Site Clearing
D. Section 32 11 23 - Aggregate Base Courses
E. Section 31 25 00 - Erosion and Sediment Control
F. Section 31 23 16 - Excavation and Backfill for Utility Trenches
G. Section 31 23 23 - Structural Fill
H. Section 01 33 00 - Submittal Procedures
I. Section 01 45 00 - Quality Control
J. Section 01 74 19 - Construction Waste Management and Disposal

1.2 APPLICABLE REFERENCES, STANDARDS, AND CODES

A. American Society for Testing and Materials (ASTM)
    a) ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
    b) ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
    c) ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
    d) ASTM D2216 - Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
    e) ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
    f) ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
    g) ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
B. Occupational Safety and Health Administration (OSHA)
    a) OSHA 29 CFR Part 1926 - Safety and Health Regulations for Construction
C. American Association of State Highway and Transportation Officials (AASHTO)
    1. AASHTO T99 - Moisture-Density Relations of Soils Using a 5.5-lb Rammer and a 12-in. Drop
    2. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop
D. International Building Code (IBC)
E. Local Building Codes and Regulations

1.3 QUALITY ASSURANCE

A. Qualifications
    1. Excavation and fill work shall be performed by a firm experienced in excavation and fill operations of similar scope and complexity.
    2. Provide qualifications of personnel and equipment upon request.
B. Testing and Inspection
    1. Engage a qualified geotechnical testing laboratory to perform soil classification, moisture content, density, and compaction testing.
    2. Testing frequency shall comply with project requirements and applicable standards or as directed by the Engineer.
    3. Field density tests shall be performed at a minimum frequency of one test per 500 square yards per lift or as specified.
C. Compliance
    1. All excavation and fill operations shall comply with OSHA safety regulations for excavation and trenching.
    2. Verify utility locations prior to excavation.
    3. Maintain alignment, grades, and elevations within tolerances specified by the Engineer.

1.4 SUBMITTALS

A. Action Submittals
    1. Excavation and Fill Plan including sequence, methods, equipment, and temporary support measures.
    2. Material submittals for fill material including source, gradation, and test reports.
    3. Equipment list proposed for excavation, hauling, and compaction.
    4. Quality control plan including testing frequency and methods.
    5. Manufacturer’s data for geotextiles or additives incorporated in fill materials.
B. Informational Submittals
    1. Soil test reports including classification, moisture content, and compaction characteristics.
    2. Records of field density and moisture tests.
    3. Reports of non-conformance and corrective actions.
    4. Project schedule updates related to excavation and fill operations.
    5. Health and safety plan related to excavation activities.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery
    a) Deliver fill materials in a manner to prevent contamination and segregation.
B. Storage

1. Store fill materials on-site in designated areas to prevent mixing with foreign materials.
2. Protect stockpiles from erosion and contamination by water, debris, and other materials.

C. Handling
1. Handle fill materials to avoid segregation and contamination.
2. Maintain moisture content of fill materials within limits required for proper compaction.

1.6 WARRANTIES

A. Provide a warranty for fill compaction and stability for a period of one year from date of final acceptance.
B. Warranty shall cover settlement, erosion, and compaction failure requiring remedial action.
C. Submit warranty documentation signed by Contractor and geotechnical engineer or testing agency.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Excavation Materials
1. Remove unsuitable materials including organic matter, debris, frozen soil, and unstable soils as directed.

B. Fill Materials
1. Granular Fill: Clean, well-graded sand, gravel, or crushed stone free of organic material and deleterious substances.
2. Structural Fill: Engineered fill meeting project gradation and compaction requirements per geotechnical recommendations.
3. Select Fill: Free from rocks larger than 2 inches, debris, and foreign matter, with plasticity index less than 15.

C. Geotextiles and Additives
1. Provide geotextiles for separation or stabilization as specified and per Section 31 05 16.
2. Additives such as lime or cement for soil stabilization shall comply with project specifications and standards.

2.2 MANUFACTURERS

A. Fill Material Suppliers
1. Lehigh Hanson Inc.
2. Vulcan Materials Company

3. Martin Marietta Materials
4. CEMEX Inc.

B. Geotextile Manufacturers
1. TenCate Geosynthetics
2. Huesker Inc.
3. Mirafi (Part of TenCate)

C. Testing and Inspection Agencies
1. Local certified geotechnical laboratories approved by the Engineer.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify site conditions and limits of excavation prior to starting work.
B. Confirm that utilities have been located and protected or removed as necessary.
C. Notify Engineer of any discrepancies, unsuitable soil conditions, or obstructions.

3.2 PREPARATION

A. Clear and grub excavation areas of vegetation, debris, and unsuitable materials.
B. Strip topsoil and stockpile separately for reuse or disposal.
C. Provide erosion and sediment control measures as specified.

3.3 EXCAVATION

A. Excavate to lines, grades, and elevations indicated on drawings or as directed.
B. Remove unsuitable or unstable materials to the depth directed.
C. Perform excavation using equipment suitable to maintain accuracy and minimize disturbance.
D. Maintain excavation slopes and shoring in compliance with OSHA requirements.
E. Remove water from excavations to maintain dry working conditions.

3.4 FILLING AND BACKFILLING

A. Place fill materials in layers not exceeding 8 inches loose thickness.
B. Maintain moisture content of fill material within optimum range for compaction.
C. Compact each layer to not less than 95 percent of maximum dry density per ASTM D698 or project-specific criteria.
D. Use mechanical compaction equipment suitable for soil type and layer thickness.
E. Scarify existing surfaces to receive new fill to promote bonding.
F. Do not place fill on frozen or muddy surfaces.

3.5 FIELD QUALITY CONTROL

A. Testing
    1. Perform field density tests using sand cone, nuclear gauge, or other approved methods.
    2. Test frequency: minimum one test per 500 square yards per lift or as directed.
    3. Perform moisture content tests in conjunction with density tests.
B. Corrective Measures
    1. Remove and replace or re-compact areas failing to meet compaction requirements.
    2. Document all corrective actions and retesting.

3.6 PROTECTION

A. Protect completed fill from erosion, disturbance, and damage.
B. Maintain drainage to prevent water accumulation on fill areas.
C. settlement, erosion, or damage at no cost to the Owner during warranty period.

3.7 CLEANING

A. Remove excess materials, debris, and equipment from site upon completion.
B. Restore adjacent areas disturbed by excavation and fill operations.

END OF SECTION 31 23 00

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures
B. Section 01 45 00 – Quality Control
C. Section 31 10 00 – Site Clearing
D. Section 31 20 00 – Earth Moving
E. Section 33 46 00 – Subdrainage
F. Section 33 11 00 – Water Utilities
G. Section 33 11 16 – Pumping and Pump Stations
H. Section 32 90 00 – Planting
I. Section 01 78 00 – Closeout Submittals

1.2 REFERENCES, CODES, AND STANDARDS

A. American Society for Testing and Materials (ASTM)
    1. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
    2. ASTM D5092 – Standard Specification for Rubber Gasket Joints for Drain and Sewer Plastic Pipes
B. American National Standards Institute (ANSI)
    1. ANSI/ASME A112.6.3 – Gravity Sanitary Drainage Systems
C. Occupational Safety and Health Administration (OSHA)
    1. OSHA 29 CFR 1926 – Safety and Health Regulations for Construction
D. International Code Council (ICC)
    1. International Building Code (IBC)
    2. International Plumbing Code (IPC)
E. National Fire Protection Association (NFPA)
    1. NFPA 70 – National Electrical Code (NEC)
F. American Water Works Association (AWWA)
    1. AWWA C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances
G. U.S. Environmental Protection Agency (EPA)
    1. EPA Stormwater Management Best Practices
H. Manufacturer standards and installation instructions

1.3 DEFINITIONS

A. Dewatering: The process of removing and controlling groundwater and surface water from construction excavations and sites to provide a dry and stable work area.

B. Pumping System: Equipment used for removing water, including pumps, piping, and discharge systems.
C. Wellpoints: Small-diameter suction wells connected to a header pipe and vacuum pumps used for lowering groundwater levels.
D. Sump: A low point excavation or pit where water collects for pumping out.

1.4 SUBMITTALS

A. Action Submittals
    1. Dewatering Plan: Detailed description of dewatering methods, equipment, sequence, and expected impacts on site and adjacent properties.
    2. Equipment Data: Manufacturer's specifications, performance curves, and capacities for pumps, wellpoints, and related equipment.
    3. Pumping System Layout Drawings: Locations of sumps, pumps, discharge lines, and monitoring points.
    4. Monitoring Plan: Methods and frequency for measuring groundwater levels and water quality.
    5. Schedule: Dewatering system installation, operation, and removal schedule aligned with construction sequencing.
    6. Safety Plan: Procedures and measures for worker safety related to dewatering operations, including confined space entry if applicable.
B. Informational Submittals
    1. Records of field tests and monitoring data.
    2. Maintenance and operation manuals.
    3. Copies of permits and approvals related to dewatering activities.
    4. Photographic documentation of pre-construction site conditions and dewatering setup.

1.5 QUALITY ASSURANCE

A. Qualifications
    1. Dewatering Contractor shall have a minimum of five years' experience successfully performing dewatering operations similar in scope and complexity.
    2. All equipment shall be certified by manufacturers and comply with applicable ANSI and ASTM standards.
B. Testing and Monitoring
    1. Dewatering system shall be monitored continuously during operation to ensure groundwater lowering meets design criteria without adverse effects on adjacent structures or environment.
    2. Provide instrumentation for groundwater level monitoring, including piezometers or observation wells as directed.
C. Compliance
    1. Comply with all applicable federal, state, and local environmental regulations, including discharge permits and stormwater management requirements.

2. Implement dust control and erosion prevention measures during dewatering.

D. Safety
    1. Follow OSHA requirements for excavation safety, electrical safety, and confined space entry.
    2. Provide appropriate personal protective equipment (PPE) and training for personnel.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment and materials in manufacturer's original packaging with labels and instructions intact.
B. Store pumps, pipes, hoses, and accessories in dry, protected areas to prevent damage and contamination.
C. Handle equipment carefully to avoid impact or deformation; use appropriate lifting devices and techniques.
D. Protect electrical components and controls from moisture and physical damage during storage and installation.
E. Maintain storage records and inspection logs to ensure material integrity prior to installation.

1.7 WARRANTY

A. Provide a minimum one-year warranty from date of substantial completion covering defects in materials and workmanship of dewatering system components.
B. Warranty shall include prompt repair or replacement of defective equipment and correction of installation deficiencies.
C. Submit written warranty documents prior to final acceptance.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Submersible Pumps:
    1. Flygt (Xylem Inc.)
    2. Grundfos
    3. Tsurumi Manufacturing Co., Ltd.
B. Wellpoint Systems:
    1. Layne Christensen Company
    2. Maccaferri Environmental Solutions
C. Pump Controls and Accessories:
    1. Siemens Industry, Inc.
    2. Allen-Bradley (Rockwell Automation)
D. Piping and Hose:

1. JM Eagle (Thermoplastic piping)
2. Continental Girbau (Flexible hose)

E. Monitoring Equipment:
1. Solinst Canada Ltd. (Piezometers and Level Loggers)
2. In-Situ, Inc.

2.2 PUMPS

A. Submersible pumps shall be suitable for continuous operation, with stainless steel or corrosion-resistant housing and impellers.
B. Pumps shall have automatic level controls or float switches to prevent dry running.
C. Capacity and head shall meet or exceed the design requirements specified in the Dewatering Plan.
D. Electrical motors shall comply with NFPA 70 and be suitable for wet or submerged applications.

2.3 WELLPOINT SYSTEMS

A. Wellpoints shall be constructed of corrosion-resistant materials with screened intake sections to prevent clogging.
B. Header piping shall be sized to provide uniform vacuum and flow distribution.
C. Vacuum pumps shall be sized to maintain required groundwater lowering with redundancy for continuous operation.

2.4 PIPING AND HOSES

A. Discharge piping shall be durable, flexible or rigid as required, resistant to abrasion, and capable of handling expected flow rates and pressures.
B. Connections shall be watertight, with fittings and joints complying with ASTM standards.
C. Provide backflow prevention where required by local codes.

2.5 CONTROLS AND MONITORING EQUIPMENT

A. Automatic control panels shall allow for start/stop operation, alarm indications, and remote monitoring capability.
B. Groundwater monitoring instruments shall be accurate to within 0.01 feet and capable of continuous data logging.
C. Provide weatherproof enclosures for all electrical components.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify site conditions, including groundwater levels, soil type, and existing utilities prior to installation.
B. Notify Architect/Engineer of any conditions detrimental to proper dewatering system performance.
C. Confirm that all required permits and approvals have been obtained.

3.2 PREPARATION

Install erosion and sediment control measures to prevent off-site discharge of pumped water.
Establish access routes and staging areas for equipment installation and maintenance.
Mark locations of all wellpoints, sumps, and discharge lines as per approved submittals.

3.3 INSTALLATION

A. Install wellpoints, pumps, piping, and controls in accordance with manufacturer instructions and approved Dewatering Plan.
B. Ensure all electrical connections comply with NEC requirements and are performed by qualified personnel.
C. Provide adequate anchoring and support for piping and equipment to prevent movement during operation.
D. Conduct initial testing of pumps and control systems to verify operation prior to dewatering commencement.

3.4 OPERATION

A. Operate dewatering system continuously as required to maintain excavation and site dry and stable.
B. Monitor groundwater levels and system performance daily, adjusting operation as necessary.
C. Maintain logs of operating parameters, maintenance activities, and monitoring data.
D. Implement immediate corrective actions in case of system failure or deviation from design criteria.

3.5 MAINTENANCE

A. Perform routine inspection and maintenance of pumps, hoses, and controls to ensure reliable operation.
B. Clean strainers, check valves, and screens regularly to prevent clogging.
C. Replace damaged or worn components promptly.
D. Maintain clear access to all equipment for inspection and repair.

3.6 SYSTEM REMOVAL AND SITE RESTORATION

A. Remove all dewatering equipment, piping, and temporary structures upon completion of excavation or as directed.
B. Restore disturbed areas to original or specified conditions, including grading and erosion control measures.
C. Dispose of water and sediment in compliance with environmental regulations and permit conditions.
D. Submit final dewatering system removal report documenting system performance and site conditions.

3.7 PROTECTION

A. Protect adjacent structures, utilities, and natural features from adverse effects of dewatering operations.
B. Monitor for potential settlement or destabilization and report immediately any observed damages.
C. Maintain barriers and signage to prevent unauthorized access to dewatering equipment and excavations.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 31 23 16 – Excavation and Fill
B. Section 31 23 23 – Trenching, Backfilling, and Compacting for Utilities
C. Section 31 23 26 – Trenching and Backfilling for Pipelines
D. Section 31 05 16 – Aggregate Subbase
E. Section 31 20 00 – Earth Moving
F. Section 33 05 13 – Utility Structures
G. Section 31 23 00 – Excavation and Backfilling for Structures
H. Section 01 33 00 – Submittal Procedures
I. Section 01 45 00 – Quality Control

1.2 REFERENCES, CODES, AND STANDARDS

A. American Society for Testing and Materials (ASTM)
    1. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
    2. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
    3. ASTM D2167 – Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
    4. ASTM D2922 – Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
    5. ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
    6. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
    7. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods
B. Occupational Safety and Health Administration (OSHA)
    1. OSHA 29 CFR 1926 Subpart P – Excavations
C. American Public Works Association (APWA)
    1. APWA Standard Specifications for Public Works Construction
D. National Fire Protection Association (NFPA)
    1. NFPA 70 – National Electrical Code (for trenching near electrical installations)
E. International Code Council (ICC)
    1. International Building Code (IBC), latest edition
F. Local, State, and Federal Codes
    1. All applicable local municipal codes and ordinances for excavation, trenching, and backfilling operations

G. U.S. Green Building Council (USGBC)
H. Other Industry Standards
    1. Manual on Uniform Traffic Control Devices (MUTCD) for work zone safety

1.3 DEFINITIONS

A. Trench: A narrow excavation made below the surface of the ground, usually deeper than it is wide, to install utilities or other infrastructure.
B. Backfill: Material used to refill an excavation or trench after installation of utilities or structures.
C. Bedding: The layer of material placed in the trench bottom to provide a stable base for pipes or structures.
D. Compaction: The process of densifying soil or backfill material to reduce voids and increase strength.

1.4 QUALITY ASSURANCE

A. Contractor Qualifications:
    1. Contractor shall have a minimum of five (5) years documented experience in trenching and backfilling similar in scope and complexity.
    2. Contractor shall maintain compliance with OSHA excavation and trenching safety requirements.
B. Testing Laboratory:
    1. Engage an independent testing laboratory to perform soil compaction and moisture content tests in accordance with ASTM standards specified.
C. Inspection and Testing:
    1. Soil classification, moisture content, and compaction density shall be verified and documented prior to backfilling.
    2. Compaction tests shall be performed at intervals not less than one test per 500 square feet or per 100 linear feet of trench, whichever is greater.
    3. Testing frequency and methods shall comply with ASTM standards D1556, D2922, and D6938.
D. Safety:
    1. Comply with OSHA 29 CFR 1926 Subpart P for excavation and trench safety, including protective systems such as shoring, shielding, or sloping.
    2. Provide traffic control measures per MUTCD standards where trenching impacts public roadways or pedestrian paths.

1.5 SUBMITTALS

1. Action Submittals:
    a. Product Data: Submit manufacturer's data on bedding and backfill materials including gradation, physical properties, and compaction characteristics.

b. Project-Specific Soil Report: Submit geotechnical report including soil classification and recommendations for trenching and backfill.
c. Work Plan: Submit detailed trenching and backfilling sequence and safety plan including shoring methods and traffic control.
d. Testing Plan: Submit proposed schedule and methods for compaction and density testing.

2. Informational Submittals:
    a. Test Reports: Submit compaction and density test results with location, date, and compliance verification.
    b. Safety Documentation: Submit OSHA trenching safety compliance records and inspection logs.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
    a. Deliver bedding and backfill materials in dry, clean condition free from contamination, organic matter, or frozen lumps.
    b. Deliver materials in quantities to prevent delay and excessive stockpiling on site.
B. Storage:
    a. Store materials on-site in designated areas protected from weather, contamination, and segregation.
    b. Segregate different types of materials to prevent mixing and contamination.
C. Handling:
    a. Handle materials to prevent contamination or degradation.
    b. Avoid mixing of materials during transport and placement.
    c. Use equipment suitable for trenching and backfilling operations to minimize damage to installed utilities and structures.

1.7 WARRANTIES

A. Contractor shall warrant trenching and backfilling work against defective workmanship and materials for a period of one (1) year from date of Substantial Completion.
B. Warranty shall include repair or replacement of settled backfill areas, improperly compacted zones, or other defects resulting from trenching and backfilling operations.
C. Provide manufacturer's warranty for any proprietary backfill or bedding materials incorporated, if applicable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bedding Material:

1. Clean, uniformly graded sand or granular material conforming to ASTM C33 or project-specific gradation requirements.
2. Particle size distribution shall ensure proper pipe support and prevent pipe movement.

B. Backfill Material:
1. Select suitable native soil free from organic material, debris, frozen lumps, and rocks larger than 2 inches unless otherwise specified.
2. Imported backfill shall meet project gradation and compaction requirements, conforming to ASTM D2487 classifications SC, SM, or GW as applicable.
3. Controlled low-strength material (flowable fill) may be used in specified trench zones as directed.

C. Controlled Low-Strength Material (CLSM):
1. CLSM shall be a flowable, self-compacting mixture of cement, fly ash, sand, and water with compressive strength between 50 and 150 psi.
2. Mix design must be submitted for approval prior to use.

D. Geotextiles and Filters:
1. Use non-woven geotextiles for separation and filtration where indicated.
2. Conform to ASTM D3786 and project-specific strength and permeability requirements.

2.2 MANUFACTURERS

A. Bedding and Backfill Materials Suppliers:
1. Vulcan Materials Company
2. Martin Marietta Materials
3. CEMEX Inc.
4. LafargeHolcim
5. Local approved aggregate producers meeting specification requirements

B. Controlled Low-Strength Material (CLSM) Providers:
1. US Concrete
2. Oldcastle Materials
3. Holcim (US) Inc.

C. Geotextile Manufacturers:
1. TenCate Geosynthetics
2. Huesker, Inc.
3. Propex Operating Company, LLC
4. Nilex Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify trench dimensions and alignment comply with contract drawings and specifications before excavation.
B. Inspect site conditions, including existing utilities and obstructions, and verify location and depth.
C. Confirm soil conditions and moisture content are suitable for trenching and backfilling.
D. Notify Architect/Engineer of unsatisfactory conditions prior to proceeding.

3.2 PREPARATION

A. Locate and protect existing utilities and structures adjacent to trenching activities.
B. Establish traffic control and safety barriers per MUTCD and OSHA requirements.

3.3 TRENCH EXCAVATION

A. Excavate trenches to required depth, width, and alignment to accommodate utilities and bedding materials.
B. Excavation shall be performed in accordance with OSHA protective system requirements to ensure worker safety.
C. Remove unsuitable or unstable material encountered in the trench bottom and replace with approved bedding or structural fill.
D. Maintain trench bottom in a smooth, uniform plane to provide continuous support.

3.4 BEDDING INSTALLATION

A. Place bedding material in trench bottom to minimum thickness specified or as recommended by Engineer.
B. Compact bedding material lightly to provide uniform support without damaging utilities.
C. Maintain moisture content of bedding material within 2% of optimum moisture for compaction.

3.5 UTILITY INSTALLATION

A. Install utility pipes, conduits, or structures in trench in accordance with manufacturers' recommendations and project drawings.
B. Verify invert elevations and alignment prior to backfilling.
C. Protect installed utilities from damage during backfilling operations.

3.6 BACKFILLING

A. Backfill trenches with approved material placed in layers not exceeding 8 inches loose thickness.
B. Compact each layer to at least 95% of maximum dry density as determined by ASTM D698 or project-specific compaction criteria.

C. Maintain moisture content within 2% of optimum for compaction for each lift.
D. Do not operate heavy equipment directly on freshly backfilled trenches until adequate compaction and curing have been achieved.
E. Where specified, use CLSM in lieu of conventional backfill and allow curing to required strength before load application.
F. Install geotextile separators or filters as indicated or directed.

3.7 FIELD QUALITY CONTROL

A. Perform in-place density testing at frequencies specified in Part 1.4.3.
B. Re-compact or replace backfill material failing to meet compaction or moisture requirements.
C. Document all testing results and corrective actions.

3.8 PROTECTION

A. Protect completed trench backfill from erosion, settlement, or damage until final surface restoration.
B. Maintain erosion control measures throughout construction period.
C. Repair or replace any damaged backfill or surfaces caused by settlement or construction activity.

3.9 CLEANING

A. Remove excess materials, debris, and equipment from trenching and backfilling operations.
B. Leave site in a neat and orderly condition.

END OF SECTION 31 23 33

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Division 01 – General Requirements
B. 31 10 00 – Site Clearing
C. 31 20 00 – Earth Moving
D. 31 23 00 – Excavation and Fill
E. 32 90 00 – Planting
F. 32 92 00 – Lawns and Grasses
G. 32 93 00 – Plants
H. 33 05 00 – Common Work Results for Utilities (for site drainage controls)
I. 33 10 00 – Water Utilities
J. 31 25 13 – Silt Fence
K. 31 25 16 – Straw Bale Barriers
L. 31 25 19 – Sediment Basins and Traps

1.2 REFERENCES, CODES, AND STANDARDS

A. American Society for Testing and Materials (ASTM)
    1. 1.2.1.1 ASTM D6462 – Standard Practice for Installation of Turf Reinforcement Mats
    2. 1.2.1.2 ASTM D5141 – Standard Guide for Sampling and Testing Silt Fence Materials
    3. 1.2.1.3 ASTM D5035 – Standard Test Method for Breaking Force and Elongation of Textile Fabrics
B. U.S. Environmental Protection Agency (EPA)
    1. 1.2.2.1 EPA Construction General Permit (CGP)
    2. 1.2.2.2 EPA Stormwater Management Best Practices
C. Federal Highway Administration (FHWA)
    1. 1.2.3.1 FHWA Hydraulic Engineering Circular No. 22 (HEC-22) – Erosion Control
D. U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS)
    1. 1.2.4.1 NRCS Conservation Practice Standards – Critical Area Planting (342), Sediment Basin (350)
E. International Code Council (ICC)
    1. 1.2.5.1 International Building Code (IBC) – Site Safety and Environmental Controls
F. State and Local Codes and Regulations – Comply with all applicable local erosion and sediment control ordinances and permits.
G. Sedimentation Control Requirements
H. Occupational Safety and Health Administration (OSHA) Standards – Safety related to erosion control installation

1.3 DEFINITIONS

A. Erosion Control – Measures used to prevent soil particles from being detached and transported by wind or water.
B. Sedimentation Control – Practices to prevent eroded soil from leaving the project site and entering water bodies or stormwater systems.

C. Temporary Controls – Erosion and sedimentation control measures implemented during construction activities and removed or replaced after site stabilization.
D. Permanent Controls – Measures installed for long-term soil stabilization and sediment control after construction completion.

1.4 ACTION SUBMITTALS

A. Product Data – Submit manufacturer's technical data, installation instructions, and material safety data sheets (MSDS) for each erosion and sedimentation control product.
B. Erosion and Sediment Control Plan – Submit a detailed plan including type, location, installation details, and maintenance procedures for all temporary and permanent controls.
C. Construction Schedule – Submit a schedule indicating timing of erosion and sedimentation control installation relative to earthwork activities.
D. Samples – Submit physical samples of key erosion control materials such as silt fence fabric, erosion control blankets, and sediment logs for approval prior to installation.
E. Certificates – Submit certification of compliance with applicable standards for manufactured erosion control products.

1.5 INFORMATIONAL SUBMITTALS

A. Inspection Reports – Submit reports from erosion and sediment control inspections performed during construction.
B. Maintenance Logs – Submit logs documenting maintenance and repair activities for erosion and sedimentation controls.
C. Qualifications – Submit qualifications of personnel responsible for installation and inspection of erosion and sedimentation controls.

1.6 QUALITY ASSURANCE

A. Installer Qualifications – Engage experienced installers with a minimum of three years' experience in erosion and sedimentation control systems similar in scope and complexity.
B. Regulatory Compliance – Comply with requirements of federal, state, and local regulatory agencies having jurisdiction over erosion and sedimentation control.
C. Inspection and Testing – Conduct inspections at intervals not exceeding seven calendar days and within 24 hours after any storm event of 0.25 inches or greater, documenting condition and performance of controls.
D. Material Compliance – Use only materials meeting the requirements of referenced standards and approved submittals.
E. Environmental Protection – Implement controls to prevent off-site sedimentation and protect water quality per EPA CGP and local permit conditions.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery – Deliver erosion and sediment control materials in original, unopened packages or containers bearing manufacturer's name, product identification, and batch number.
B. Storage – Store materials in a clean, dry location protected from exposure to sunlight, moisture, and contaminants.

C. Handling – Handle materials to prevent damage; avoid dragging or dropping materials. Protect fabric and blankets from tearing, punctures, or deterioration during installation.
D. Stockpile Management – Stockpile soil and erosion control materials away from drainage courses and protected by temporary controls to prevent sediment runoff.

1.9 WARRANTY

A. Manufacturer's Warranty – Provide manufacturer's standard warranty for erosion control products against defects in materials and workmanship for a minimum period of one year from date of installation.
B. Installer's Warranty – Installer shall warrant that erosion and sedimentation controls have been installed in accordance with manufacturer's instructions, project specifications, and approved plans for a minimum period of one year from date of acceptance.
C. Corrective Action – Promptly repair or replace erosion and sediment control measures found defective or failing within warranty period at no cost to the Owner.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Silt Fence and Sediment Control Products:
    1. Tenax Corporation
    2. North American Green, LLC
    3. Stormwater Management, Inc.
    4. Filtrexx International LLC
    5. Mirafi (TenCate)
B. Erosion Control Blankets and Turf Reinforcement Mats:
    1. North American Green, LLC
    2. Curlex (American Excelsior Company)
    3. Propex Global
    4. Profile Products LLC
    5. West Coast Turf Products
C. Straw Bales and Wattles:
    1. Local agricultural suppliers (certified weed free)
D. Sediment Basins and Check Dams:
    1. Stormwater Management, Inc.
    2. ADS (Advanced Drainage Systems)
    3. ACF Environmental, Inc.

2.2 MATERIALS

A. Silt Fence Fabric
    1. Filter fabric shall be a woven or non-woven synthetic geotextile meeting ASTM D5141 and ASTM D5035 requirements.
    2. Minimum tensile strength: 120 lbs per ASTM D5035.
    3. Apparent opening size (AOS): 30 to 50 US standard sieve size.
B. Posts for Silt Fence

1. Wood posts: Untreated, minimum 2 inch by 2 inch by 48 inches in length.
2. Steel posts: U-shaped with minimum 1.33 lb/ft weight and minimum 48 inches long.

C. Erosion Control Blankets and Mats
1. Biodegradable blankets composed of straw, coconut fiber, or wood excelsior with UV degradation within 12 months.
2. Turf reinforcement mats made of synthetic materials with minimum 5-year durability.

D. Straw Bales
1. Certified weed-free, well-tied, minimum dimensions 14 inches by 18 inches by 36 inches.

E. Sediment Logs and Wattles
1. Cylindrical tubes filled with straw, coconut fiber, or composted materials encased in UV resistant netting.

F. Sediment Basins and Check Dams
1. Constructed of rock, gravel, or manufactured structural materials as per design requirements.

G. Filter Bags and Fabric Tubes
1. Durable, UV stabilized geotextile fabric designed for sediment filtration and water flow.

2.3 ACCESSORIES

A. Stakes, wire, staples, and fasteners compatible with erosion control materials and installation requirements.
B. Biodegradable erosion control mesh or twine for securing blankets and mats.
C. Warning and safety signage as required by OSHA and local regulations.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are acceptable for erosion and sedimentation control installation including grading, drainage patterns, and soil conditions.
B. Confirm that necessary permits, approvals, and erosion control plans have been received and reviewed.
C. Inspect delivered materials for compliance with specifications and storage conditions.

3.2 PREPARATION

A. Clear and grub areas of vegetation and debris only as necessary to install erosion and sediment controls.
B. Protect existing vegetation and natural buffers not designated for removal.
C. Prepare soil surfaces for installation of erosion control blankets and mats by smoothing and ensuring proper moisture content.

3.3 INSTALLATION

A. 3.3.1 Silt Fence
1. Install silt fence along contour lines as shown on erosion control plans, prior to commencement of earthwork.

2. Excavate trench at least 6 inches deep to anchor fabric and backfill with compacted soil.
3. Secure fabric to posts with staples or wire ties at maximum 12 inches on center.
4. Posts shall be spaced a maximum of 6 feet apart.
5. Overlap fabric ends a minimum of 12 inches at joints.

B. 3.3.2 Straw Bale Barriers
1. Install on level contour lines with stakes driven through bales at minimum 24 inches on center.
2. Place bales end-to-end with minimal gaps and securely tethered.
3. Backfill and compact soil on uphill side to prevent water flow beneath bales.

C. d. Replace bales as they deteriorate or become ineffective.

D. 3.3.3 Erosion Control Blankets and Turf Reinforcement Mats
1. Install on slopes steeper than 3:1 or as indicated on plans.
2. Anchor blankets with staples or pins at spacing recommended by manufacturer.
3. Overlap adjacent blankets a minimum of 6 inches following manufacturer's instructions.
4. Seed and fertilize soil prior to blanket installation unless otherwise directed.

E. 3.3.4 Sediment Basins and Traps
1. Construct basins according to design drawings and NRCS standards.
2. Install outlet structures and energy dissipation devices as specified.
3. Maintain basins free of sediment accumulation exceeding design capacity.

F. Sediment Logs and Wattles
1. Install along contour lines or at perimeter of disturbed areas.
2. Secure firmly to ground with stakes placed at intervals not exceeding 4 feet.

G. Temporary Diversions and Drainage Controls
1. Construct berms, ditches, or swales to divert runoff away from disturbed areas.
2. Use temporary piping or lined channels as required to prevent erosion.

3.4 MAINTENANCE AND MONITORING

Perform weekly inspections and after storm events to assess condition and effectiveness of erosion and sediment controls.
Repair or replace damaged or ineffective controls immediately.
Remove accumulated sediment from behind controls when sediment reaches 50 percent of barrier height.
Maintain controls until disturbed areas are permanently stabilized with vegetation or other approved measures.
Document maintenance activities and inspection results in logs submitted as per 1.5.2.

3.5 REMOVAL

Remove temporary erosion and sedimentation controls after final site stabilization is achieved and as approved by the Owner or governing agencies.
Dispose of removed materials in accordance with local regulations and environmental requirements.
Restore disturbed areas caused by removal operations to original or specified condition.

3.6 PROTECTION

A. Protect installed erosion and sedimentation controls from damage by construction activities and equipment.

B. Restrict access and vehicle traffic over protected areas.
C. Provide signage and barriers as required for public and worker safety.

END OF SECTION

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 but are not limited to:
    1. Section 31 20 00 – Earth Moving
    2. Section 31 23 00 – Excavation and Fill
    3. Section 31 23 33 – Excavation and Fill for Structures
    4. Section 31 23 19 – Trenching and Backfilling
    5. Section 31 25 13 – Soil Erosion and Sedimentation Control
    6. Section 31 25 16 – Sedimentation Basins
    7. Section 32 92 00 – Turf and Grasses
    8. Section 32 93 00 – Plants
    9. Section 32 84 00 – Irrigation
    10. Section 01 33 00 – Submittal Procedures
    11. Section 01 45 00 – Quality Control
    12. Section 01 57 00 – Temporary Controls

1.2 REFERENCES, CODES, AND STANDARDS

A. Applicable codes and standards include, but are not limited to:
B. American Society for Testing and Materials (ASTM)
    1. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
    2. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
    3. ASTM D5035 – Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method).
    4. ASTM D6988 – Standard Guide for Field Testing and Monitoring of Vegetation and Soil Quality on Construction Sites.
C. U.S. Environmental Protection Agency (EPA)
    1. EPA 832-R-92-005 – Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.
D. U.S. Department of Agriculture Natural Resources Conservation Service (NRCS)
    1. NRCS Conservation Practice Standards – Critical Area Planting (Code 342).
    2. NRCS Conservation Practice Standards – Mulching (Code 484).
E. Occupational Safety and Health Administration (OSHA)
    1. OSHA 29 CFR Part 1926 – Safety and Health Regulations for Construction.
F. American Society of Civil Engineers (ASCE)
    1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures (for applicable loading on stabilization structures).

G. Local and State Codes and Ordinances for erosion control and sedimentation prevention.

1.3 SUBMITTALS

A. Action Submittals:
    1. Product Data: Submit manufacturer's product data, including physical, chemical, and performance characteristics, installation instructions, and maintenance recommendations.
    2. Shop Drawings: Submit detailed drawings illustrating erosion and sedimentation control measures including dimensions, materials, locations, and anchorage details.
    3. Samples: Submit representative samples of stabilization materials, including fabric, mulch, seed mixtures, and soil amendments.
    4. Construction Schedule: Submit schedule indicating timing and sequence of erosion control installation, monitoring, and maintenance.
    5. Quality Control Plan: Submit plan detailing inspection, testing, and monitoring procedures for stabilization measures.
B. Informational Submittals:
    1. Manufacturer's Certificates: Certify that products comply with specified requirements.
    2. Soil Analysis Reports: Submit laboratory soil test results to verify suitability for stabilization measures.
    3. Maintenance and Monitoring Reports: Submit documentation of periodic inspections and maintenance activities as required.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
    1. Engage installers who have a minimum of five years' experience in installation of erosion and sedimentation control stabilization measures similar in scope and complexity.
B. Testing Agency:
    1. Engage a qualified independent testing laboratory to perform required soil compaction and material quality tests.
C. Regulatory Compliance:
    1. Perform work in accordance with all applicable federal, state, and local regulations pertaining to erosion control and sedimentation prevention.
D. Performance Criteria:
    1. Stabilization measures shall prevent erosion and sediment loss during and after construction as demonstrated by monitoring and inspection.
E. Environmental Protection:
    1. .1 Implement measures to minimize adverse environmental impact including protection of existing vegetation and watercourses.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened containers or bundles with labels intact and legible.
B. Store materials in a dry, protected location off the ground and protected from sunlight, moisture, and contamination.
C. Handle materials to prevent damage or deterioration.
D. Protect temporary erosion control devices from damage during construction operations.
E. Store seed and mulch materials in accordance with manufacturer recommendations to maintain viability.

1.6 **WARRANTIES**

A. Provide a minimum warranty period of two years from date of final acceptance for all stabilization measures installed under this Section.
B. Warranty shall cover repair or replacement of materials and corrective work required due to failure of erosion and sediment control stabilization measures.
C. Provide manufacturer's standard product warranties for erosion control fabrics, mats, and other proprietary materials.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Erosion Control Blankets and Mats:
    1. Biodegradable erosion control blankets composed of natural fibers such as straw, coconut coir, or wood excelsior, complying with ASTM D6475.
    2. Synthetic erosion control mats constructed of UV stabilized polypropylene or polyethylene fibers, resistant to degradation, compliant with ASTM D6459.
B. Soil Stabilization Fabrics:
    1. Woven and nonwoven geotextiles manufactured from polypropylene or polyester, UV stabilized, meeting ASTM D5035 and ASTM D4873 requirements.
C. Mulch Materials:
    1. Straw mulch free of noxious weeds and seeds.
    2. Wood cellulose mulch compliant with NRCS standards.
    3. Hydromulch mixtures formulated for erosion control and seed germination.
D. Seed Mixes:
    1. Provide seed mixtures consisting of native or adapted species selected for site conditions and erosion control effectiveness. Seed shall be certified and meet purity and germination requirements per local standards.
E. Soil Amendments:

1. Fertilizers, lime, and soil conditioners as recommended by soil testing laboratory to promote vegetation establishment.

F. Anchoring Devices:
    1. Staples, pins, and stakes fabricated from corrosion-resistant materials sized and spaced per manufacturer's recommendations for securing stabilization materials.

2.2 MANUFACTURERS

A. Erosion Control Blankets and Mats:
    1. North American Green
    2. Profile Products LLC
    3. American Excelsior Company
    4. Western Excelsior
    5. Curlex® by American Excelsior
B. Soil Stabilization Fabrics:
    1. TenCate Geosynthetics
    2. Propex Operating Company, LLC
    3. Huesker, Inc.
C. Mulch and Hydromulch:
    1. Seed Research of Oregon
    2. HydroStraw®
    3. WoodStraw®
D. Seed Suppliers:
    1. Native Seed Network
    2. Ernst Conservation Seeds
    3. Wildflower Farms

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that earthwork and grading operations are complete and conform to lines, grades, and elevations specified.
B. Confirm that soil surface is free of debris, clods, rocks, and foreign materials that would interfere with stabilization materials.
C. Inspect soil moisture content and texture to ensure suitability for seed germination and material installation.
D. Notify Architect/Engineer of unsatisfactory conditions prior to proceeding.

3.2 PREPARATION

A. Scarify or roughen soil surface as required to provide a suitable bonding surface for stabilization measures.

B. Apply soil amendments, fertilizer, and lime uniformly per soil test recommendations.
C. Grade soil surface smooth and uniform without low spots or depressions that could pond water.
D. Moisten soil as necessary before seeding and installation of erosion control materials.

3.3 INSTALLATION OF STABILIZATION MEASURES

A. Seeding:
    1. Apply seed uniformly at specified rates using mechanical or hand spreaders.
    2. Lightly rake or drag seeded area to incorporate seed into soil surface to a depth of 0.5 inch (13 mm).
    3. Apply fertilizer and lime if not previously applied during preparation.
B. Mulching:
    1. Apply mulch evenly over seeded areas at thickness recommended by manufacturer and NRCS standards.
    2. Secure mulch with tackifiers or netting as specified to prevent displacement.
C. Erosion Control Blankets and Mats:
    1. Place blankets or mats immediately after seeding and mulching or as directed.
    2. Lay blankets smooth and tight without wrinkles or folds, overlapping edges per manufacturer's instructions.
    3. Anchor blankets with staples or pins at spacing recommended by manufacturer, ensuring secure attachment to soil surface.
    4. Overlap adjacent sections minimum 6 inches (150 mm) along edges and 12 inches (300 mm) at ends.
D. Soil Stabilization Fabrics:
    1. Install geotextiles in accordance with manufacturer's instructions and project drawings.
    2. Excavate trenches at edges where required for fabric anchorage and bury fabric securely.
    3. Maintain fabric tension and alignment during installation to prevent wrinkles or displacement.
E. Temporary Stabilization:
    1. Apply temporary seeding or mulching on disturbed areas not actively worked for longer than 14 days.
F. Permanent Stabilization:
    1. Establish permanent vegetative cover on all disturbed areas as soon as practical after final grading.

3.4 FIELD QUALITY CONTROL

A. Perform inspections of installed stabilization measures at intervals not exceeding 14 days and after significant rainfall events.
B. Verify proper installation, anchorage, and condition of erosion control materials.

C. Inspect seeded areas for germination, uniformity, and coverage.
D. Identify and repair areas of erosion, displacement, or failure promptly.
E. Testing: Perform soil compaction tests in areas where soil stabilization fabrics are installed to verify compaction meets ASTM D698 or project requirements.
F. Documentation: Maintain detailed inspection and maintenance logs including dates, observations, and corrective actions.
G. Notify Architect/Engineer immediately of any nonconformance or damage requiring corrective action.

3.5 MAINTENANCE

A. Maintain erosion and sediment control stabilization measures continuously until permanent vegetation is established and site is stabilized.
B. Water seeded areas as required to promote germination and growth without causing erosion.
C. Repair or replace damaged erosion control materials promptly.
D. Remove sediment deposits from silt fences, basins, and other control devices when accumulation reaches 50 percent of design capacity.
E. Control weeds and invasive species to prevent establishment and damage to stabilization measures.
F. Continue maintenance activities for a minimum period of two years or until site is permanently stabilized.

3.6 PROTECTION

A. Protect installed stabilization measures from traffic, equipment, and other construction activities.
B. Provide temporary fencing or barricades as necessary to prevent disturbance.
C. Coordinate with other trades to avoid damage during concurrent operations.

3.7 CLEANING

A. Remove and legally dispose of all construction debris, excess materials, and temporary erosion control devices upon completion of work.
B. Leave site clean and free of erosion and sedimentation hazards.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Perform foundation and under floor termite control treatment in accordance with the Arkansas Pest Control Law and to qualify construction under this Contract for continuous guaranteed protection specified.

B. Applicable Regulations:
   1. International Building Code
   2. Arkansas Pest Control Law.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 3000.
   1. Copy of applicator’s state license.
   2. Proof that the proposed chemical treatment is permitted by state plant board.
   3. Copy of required 5 year Damage Guaranty Contract

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 GUARANTEE

A. Furnish damage guarantee with service and re-service for any subterranean termite infestation without cost to Owner. Write Damage Guaranty Contract additionally to cover any and all subterranean termite damage to the structures and contents in amount of $10,000.00. Such damage to be repaired, replaced or corrected at Contractor's expense.

B. Furnish damage guarantee effective for 5 year period after completion of initial treatment without payment of additional fees or premiums by Owner. Upon expiration of 5-year period, Owner has option of extending damage guarantee contract at an annual fee mutually agreed upon by Owner and applicator. Owner reserves the right to cancel as of any anniversary date. Service, re-service, and Damage Guaranty provisions of the extended damage contract are noncancellable by applicator. Annual fee subject to revision by giving advance written notice to Owner.

PART 2 - PRODUCTS

2.01 TERMITE CONTROL CHEMICALS

A. Use chemicals approved by the Arkansas State Plant Board and of type required to give guaranteed protection specified.

PART 3 - EXECUTION

3.01 PREPARATION

A. From investigation at the site determine soil texture or otherwise obtain this information from the County Agent, Soil Conservation Service or other approved authorities, if not already known.

B. Remove wood and cellulose containing materials from earth sub-grade to be treated before chemical is applied.

3.02 TREATMENT

A. Perform foundation and under floor termite control treatment at buildings to be constructed under this Contract. Use type chemical approved by the Arkansas State Plant Board and currently known to give guaranteed protection for the soil and fill used at this Project. Apply chemical using applicator licensed by the Arkansas State Plant Board. Apply in sufficient quantity under and around the structures, to qualify building and contents for continuous guaranteed protection against damage by subterranean termites.

B. Reapply soil treatment solution to areas disturbed by subsequent excavation or construction activities following application.

C. Under Slabs: Apply under slabs at the rate recommended by manufacturer. Apply after placement of gravel drainage fill and immediately prior to placement of vapor barrier . When necessary to insure proper penetration, the ground surface will be left loose or lightly scarified until treatment has been completed.

D. Critical Areas: Treat a one foot strip along critical areas under walls, around interior piers and pipes rising from the ground at the rate recommended by manufacturer. Treatment shall be applied as specified for overall treatment under slabs.

E. Outside of Foundations: Apply a one foot strip along the outside of the foundations of the building at the rate recommended by manufacturer. Apply in a trench dug to a depth of approximately 2" below finish grade. Loosen earth in trench to a depth of 12" before treating. This treatment is to be performed prior to finish grading.

3.03 PROTECTION

A. Unless treated surfaces are to be immediately covered, take means necessary to prevent disturbance of treated areas by human or animal contact.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Design, furnish, and install aggregate pier foundations to lines and grades designated on the project foundation plans and as specified herein. Construct aggregate piers by compacting aggregate in an excavated hole using special high-energy impact densification equipment. Provide columnar-type configuration aggregate piers used to produce an intermediate foundation system for support of foundation loads.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 3000.
   1. Submit detailed design calculations, construction drawings, and shop drawings for approval at least 2 weeks prior to the beginning of construction. A detailed explanation of the design properties for settlement calculations shall be submitted with the design. Additionally, the quality control test program for aggregate piers, meeting these design requirements, shall be submitted. All computer generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State of Arkansas.
   2. Submit a notarized manufacturer's certification, prior to start of work, stating that the aggregate and other materials used meet specified requirements.
   3. Daily Aggregate Pier Progress Reports: The Testing Agency shall furnish a complete and accurate record of aggregate pier installation to the General Contractor, and Architect. The record shall indicate the pier location, diameter, length, average lift thickness, and final elevations of the base and top of pier. The record shall also indicate the type and size of the densification equipment used. Immediately report any unusual conditions encountered during installation to the General Contractor, to the aggregate pier designer, and to the Architect.
   4. Submit Geopier Modulus Testing and Uplift Load Testing Modifications to Architect.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCE STANDARDS

A. Design:

1. "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng. Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia.
2. "Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers," by Evert C. Lawton and Nathaniel S. Fox. Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments, ASCE,2, 962-974.
3. Geopier Reference Manual, by Nathaniel S. Fox and M. Cowell, 1998; Geopier Foundation Company, Inc. Scottsdale, AZ.
4. "Behavior of Geopier-Supported Foundation Systems During Seismic Events", by K.J. Wissmann and E.C. Lawton, and T.M. Farrell, 1999. Technical Bulletin No. 1; Geopier Foundation Company, Inc., Scottsdale, AZ.
5. "Bearing Capacity of Geopier Supported Foundation Systems", by K.J. Wissmann, 1999. Technical Bulletin No. 2; Geopier Foundation Inc., Scottsdale, AZ.
6. "Geopier Uplift Resistance", by K.J. Wissmann, J.M. Caskey, and B.T. Fitzpatrick, 2001. Technical Bulletin No. 3; Geopier Foundation Inc., Scottsdale, AZ.
7. "Geopier Lateral Resistance", by K.J. Wissmann, B.T. Fitzpatrick, and E.C. Lawton, 2001. Technical Bulletin No. 4; Geopier Foundation Inc., Scottsdale, AZ.
8. "Geopier Shear Reinforcement for Global Stability and Slope Stability", by K.J. Wissmann and B.T. Fitzpatrick, 2002. Technical Bulletin No. 5; Geopier Foundation Inc., Scottsdale, AZ.

B. Modulus and Uplift Load Testing: (Refer to paragraph 1.5, C, for modification requirements to referenced standards.)
1. ASTM D-1143 - Pile Load Test Procedures
2. ASTM D-1194 - Spread Footing Load Test
3. ASTM D-3689 - Uplift Load Test

C. Materials and Inspection:
1. ASTM D-1241 Aggregate Quality
2. ASTM STP 399 - Dynamic Penetrometer Testing
3. ASTM D-422 - Gradation of Soils
4. Bottom Stabilization Test (BSTA) - Geopier Method.

1.05 DESIGN REQUIREMENTS

A. The design submitted by the Aggregate Pier Installer shall consider the bearing capacity and settlement of all footings supported by aggregate piers, and shall be in accordance with acceptable engineering practice and these specifications. Total and differential settlement shall be considered. The design life of the structure shall be 50 years, unless otherwise indicated by the Owner.

B. Aggregate Pier Design:
   1. Design Aggregate piers in accordance with generally-accepted engineering practice and the method described in "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton, Nathaniel S. Fox, and Richard L. Handy, reprinted from IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia. The design shall meet the following criteria:
   2. Minimum Allowable Bearing Pressure for Aggregate Pier Improved Soil; 7000 psf all footings
   3. Minimum Aggregate Pier Area Coverage (Spread Footings); 30%.
   4. Estimated Total Long-Term Settlement For Footings; < 1 inch.
   5. Estimated Long-Term Differential Settlement For Adjacent Footings; < 0.5 inches.
   6. Column Reaction: Provided as requested.

C. Capacity and Size of the Aggregate Piers: Size and spacing shall be determined by design criteria for project conditions. The Installer shall be responsible for delivering a system that will support the structure, while controlling settlement in accordance with these specifications. The Geopier Engineer shall submit modifications in size and spacing of the aggregate piers for approval Architect.

D. Provide Geopier modifications to reference standards for modulus and uplift load testing. Uplift test required only on columns with uplift indicated in the reactions, provided in a separate document during the shop drawings phase or as shown on the drawings. A maximum of six column footings will be required to have uplift test.

1.06 QUALITY ASSURANCE/QUALITY CONTROL

A. The Aggregate Pier Installer shall have a full-time Quality Control representative to verify and report all quality control procedures. The Aggregate Pier Installer shall provide and install all dial indicators and other measuring devices required for load tests. The Installer shall adhere to all methods, standards, and codes described herein, unless authorized in writing by the Architect.

B. The Testing Agency, paid for by the General Contractor, shall monitor the installation of aggregate piers. The Testing Agency shall provide Quality Assurance services and shall monitor the modulus and uplift load tests to be performed. The Testing Agency shall monitor the installation of the load test aggregate piers to verify that production installation practices are similar to

those used during the installation of the modulus test elements. The Testing Agency shall perform Dynamic Cone Penetrometer Tests specified with this section. Testing Agency shall report any discrepancies to the Aggregate Pier Installer and Architect immediately.

PART 2 - PRODUCTS

2.01 AGGREGATE

A. Aggregate used for piers constructed above the water table shall be AHTD Class 7 aggregate base or Type I Grade B in accordance with ASTM D-1241-68, or shall be other graded aggregate selected by the Aggregate Pier Installer and approved by Architect and successfully used in the modulus test. It shall be compacted to a densification and strength which provides resistance to the dynamic penetration test (ASTM STP 399) of a minimum average of 15 blows per 1.75 inch vertical movement.

B. The number of tests performed during a workday by the Testing Agency shall depend on the consistency of achieving this minimum penetration resistance. Penetration tests need not be performed on every pier, nor on a continuous basis. Perform a minimum of two dynamic penetration tests for each days work. Perform additional tests that may be required by the Testing Agency or Architect. If average penetration resistances measured exceed 15 blows per 1.75" penetration, and less than 10% of tests fall below this value, then testing may be reduced to spot checks. A pattern of successful tests in sufficient to reduce testing to several tests per day. Observation of questionable aggregate moisture content or questionable aggregate gradation appearance may determine the need for additional dynamic penetration testing to verify that proper densification and strength are being achieved.

C. For aggregate used for piers constructed below the water table, the gradation shall be the same as Type I Gradation B, except that particles passing the No. 40 sieve shall be eliminated. Alternately, No. 57 stone, "C" ballast, or other stone selected by the Aggregate Pier Installer and approved by the Architect, may be used. Do not perform dynamic penetration resistance testing for this material.

D. Water: Potable. To increase aggregate moisture content as required by project conditions determined by Aggregate Pier Installer.

PART 3 - EXECUTION

3.01 PREPARATION

A. The General Contractor shall locate and protect underground and above ground utilities and other structures from damage during installation of the Aggregate Pier elements.

B. The General Contractor will provide the site to the Installer, after earthwork in the area has been completed.

C. Site subgrade shall be established by the General Contractor within 6" of final design subgrade, as approved by the Architect.

D. A working surface will be established and maintained by the General Contractor to provide wet weather protection of the subgrade and to provide access for efficient operation of the Aggregate Pier installation.

3.02 INSTALLATION

A. Layout of Aggregate Piers: The General Contractor shall provide layout of aggregate pier-supported footings, mats, or grade beams for this project, including layout of piers. The General Contractor shall provide ground elevations in sufficient detail to estimate drilling depth elevations to within 2 inches.

B. Excavation: The General Contractor shall coordinate all excavations made subsequent to the Aggregate Pier installations so that at least five feet of horizontal distance remains between the edge of any installed Aggregate Pier and the excavation. Protection of completed Aggregate Pier elements is the responsibility of the General Contractor. In the event that utility excavations are required at horizontal distances of less than five feet from installed Aggregate Piers, the General Contractor shall contact the Aggregate Pier Designer to develop construction solutions to minimize impacts of the installed Aggregate Piers. Recommended procedures may include:
   1. Using cement-treated base to construct portions of the Aggregate Piers subject to future excavations.
   2. Replacing excavated soil with compacted crushed stone in the portions of the excavations where the Aggregate Piers have been distrubed. The placement and compaction of the crushed stone shall meet the following requirements:
      a. The crushed stone shall meet the gradation specified by the Geotechnical Engineer in the referenced Geotechnical Engineering Report or as required due to conditions found at time of excavation.
      b. The crushed stone shall be placed in a controlled manner using motorized impact compaction equipment.
      c. The aggregate should be compacted to 95% of the maximum dry density as determined by the modified Proctor method (ASTM D 1557).
      d. The Testing Agency shall be onsite to observe placement, compaction and provide density testing. The test results shall be submitted to the Architect and General Contractor. The General Contractor shall provide notification to the Testing Agency and the Designer when excavation, placement and compaction will occur and arrange for construction observation and testing.

C. Aggregate Pier Excavation: Should any obstruction be encountered during drilling or excavation for aggregate piers, the General Contractor shall be responsible for removing such obstructions, or the pier shall be relocated or abandoned. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., which shall prevent placing the piers to the required depth, or shall cause the pier to drift from the required location. Dense natural rock or weather rock layers shall not be deemed obstructions, and piers may be terminated short of design lengths on such materials, if approved by Architect.
   1. All Aggregate Pier elements shall be pre-augered using mechanical drilling or excavation equipment. Do not allow installation of piers without pre-augering to prevent significant disturbance and remolding of matrix soils surrounding piers.
   2. Provide steel casing or drilling slurry to stabilize excavations if cave-ins occur during excavation or if sidewalls are deemed unstable.

3. If cave-ins occur on top of a lift of aggregate such that the volume of the caved soils is greater than 10% of the volume of the aggregate in the lift, then the aggregate shall be considered contaminated and shall be removed and replaced.

D. Modulus Test: A modulus test shall be performed to verify the parameter values selected for design. The modulus tests shall be of the type and installed in a manner specified below:
1. A telltale shall be installed at the bottom of the test pier so that the bottom-of-pier deflections may be determined. Acceptable performance is indicated when the bottom of the pier deflection is no more than 20% of the top of pier deflection at the design stress level.
2. ASTM D 1143 general test procedures shall be used as a guide to establishing load increments, load increment duration, and load decrements.
3. With the exception of the load increment representing approximately 115% of the design maximum top of the Aggregate Pier stress, all load increments shall be held for a minimum of 15 minutes, a maximum of 1 hour, and until the rate of deflection reduces to 0.01 inch per hour, or less.
4. The load increment that represents approximately 115% of the design maximum stress on the Aggregate Pier shall be held for a minimum of 15 minutes, a maximum of 4 hours and until the rate of deflection reduces to 0.01 inch per hour or less.
5. A seating load equal to 5 percent of the total load shall be applied to the loaded steel plate prior to the application of load increments and prior to measurement of deflections to compensate for superficial disturbance.

E. Uplift Load Test:
1. Uplift load test procedures shall be conducted in general accordance with ASTM D 3689, as appropriate and except as modified in this section and uplift aggregate pier testing shall be performed in accordance with the requirements as specified in this Section.
2. The location of the uplift load test should be coordinated with the project Geotechnical Engineer.
3. Uplift load test information shall be used to verify that the aggregate pier system design is consistent with the behavior exhibited during the uplift load test.

F. Bottom Stabilization Verification Test: After completion of the bottom pier bulb, or at anytime during the process of constructing the pier, the energy source may be turned off, and a bottom stabilization verification test may be performed. These tests shall be performed when a new soil formation is encountered, at the beginning of a project to provide quantitative information on pier stabilization or as directed by the Testing Agency and Architect. A minimum of two tests per day shall be performed. A reference bar is placed over the cavity, marking the tamper shaft, applying energy to the tamper for additional 15 seconds, and then observing downward deflection of tamper shaft. Acceptable performance is indicated if the vertical movement of the shaft is less than 150% of the vertical movement measured for the modulus test pier. If the measured vertical movement exceeds 150% of the value achieved during the modulus test, added energy is applied to redensify the bulb. The procedure for measuring is then repeated. If there is still movement greater than 150% of that achieved during the load test and greater than 1/2 inch, a lift of loose aggregate may be placed on top of the compacted

aggregate, and the verification test may be performed on this next lift after it is densified. If there is excessive movement on this lift, another lift may be placed and tested. Movement must be limited to below 150% of the values achieved for the load test before completion of 2/3 of the pier depth.

G. Dynamic Cone Penetrometer Test:
   1. Test Aggregate Pier elements in accordance with the Dynamic Cone Penetrometer method, ASTM STP 399, at locations within the upper 1/3 of the pier shaft length.
   2. Minimum acceptable criteria as an indicated of acceptable densification shall be a specified in paragraph 2.01.A.
   3. Perform test in each Aggregate Pier until such time as five consecutive tests indicate that the minimum criterion is met. Thereafter, such tests need not be preformed on every pier, provided the aggregate used in the elements is representative of that previously tested. If average penetration resistances measured exceed 15 blows, and less than 10% of tests fall below 15 blows, then testing may be reduced to spot checks. A pattern of successful tests is sufficient to reduce testing to verify that the proper densification is being achieved.
   4. Use of Dynamic Cone Penetrometer is not appropriate for use of open graded aggregate such as No. 57 stone.

H. Rejected Aggregate Piers: Abandon and replace with new piers aggregate piers improperly located or installed beyond the maximum allowable tolerances, unless Architect approves other remedial measures. Provide material and labor required to replace rejected aggregate piers at no additional cost to the Owner.

I. Densification:
   1. Use a special high-energy impact densification apparatus to densify the Aggregate Pier elements during installation. The apparatus shall apply direct downward impact energy to each lift of aggregate.
   2. The bottom of the excavation shall be densified prior to the placement of the aggregate. If wet, soft or sensitive soils are present, open-graded aggregate, such as ASTM No. 57 stone or other, shall be placed at the bottom of the excavation and compacted to stabilize the element bottom and may serve as the initial lift.
   3. Downward pressure shall be applied to the tamper shaft during tamping.
   4. Each lift of aggregate shall be tamped for a minimum of 10 seconds.

J. Plan Location and Elevation of Aggregate Piers: Provide center of each pier within six inches of the plan locations indicated. The final measurement of the top of aggregate piers shall be the lowest point on the aggregate in the last compacted lift. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

K. Footing Bottoms:
   1. Foundation excavations to expose the tops of the Aggregate Pier elements shall be made in a workmanlike manner, and shall be protected until the concrete placement, with procedures and equipment best suited to prevent softening of the matrix soil between and around the Aggregate Pier elements before pouring structural concrete, and achieving direct and firm contact between the dense, undisturbed Aggregate Pier elements and the concrete footing.

2. Recommended procedures:
   a. Limit over excavation below the bottom of footing elevation to 3 inches. This includes limiting the teeth from excavators from over excavation beyond 3 inches below the footing elevation.
   b. Compaction of surface soil and top of Aggregate Pier elements using equipment appropriate for project conditions. Note: Sled type tamping devices shall not be used. Perform compaction over the entire footing bottom to compact any loose surface soil and loose surface pier aggregate.
   c. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as excavation. Footing concrete must be placed on the same day if the footing is bearing on expansive or sensitive soils.
   d. If same day placement of footing concrete is not possible, place a minimum 3" thick lean concrete seal (mud mat) immediately after the footing is excavated and approved.
3. The following criteria shall apply, and a written inspection report sealed by the project Geotechnical Engineer shall be furnished to Architect to confirm:
   a. That water (which may soften the unconfined matrix soil between and around the Aggregate Pier elements, and may have detrimental effects on the supporting capability of the Aggregate Pier reinforced subgrade) has not been allowed to pond in the footing excavation at any time.
   b. That all Aggregate Pier elements designed for each footing have been exposed in the footing excavation.
   c. That immediately before footing construction, the tops of all the Aggregate Pier elements exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment, and that the tops of any Aggregate Pier elements which may have been disturbed by footing excavation and related activity have been recompacted to a dry density equivalent to at least 95% of the maximum dry density obtainable by the modified Proctor method (ASTM D1557).
   d. That no excavations or drilled shafts have been made after installation of Aggregate Pier elements within horizontal distance of five feet from the edge of any pier, without the written approval of the Architect.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Division 01 – General Requirements
B. Section 31 20 00 – Earth Moving
C. Section 32 05 23 – Aggregate Base Courses
D. Section 32 12 16 – Asphalt Paving
E. Section 32 13 13 – Concrete Paving
F. Section 03 30 00 – Cast-in-Place Concrete
G. Section 31 23 00 – Excavation and Fill for Utilities
H. Section 32 01 23 – Concrete Paving Joint Sealants
I. Section 32 05 26 – Concrete Pavement Repair Materials

1.2 REFERENCES, CODES, AND STANDARDS

A. American Concrete Institute (ACI)
    1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
    2. ACI 318 – Building Code Requirements for Structural Concrete
    3. ACI 301 – Specifications for Structural Concrete
B. American Society for Testing and Materials (ASTM)
    1. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
    2. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
    3. ASTM C94 – Standard Specification for Ready-Mixed Concrete
    4. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
    5. ASTM C157 – Standard Test Method for Length Change of Hardened Hydraulic-Cement Concrete
    6. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete
    7. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete
    8. ASTM C928 – Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
    9. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction
    10. ASTM D6690 – Standard Specification for Joint Sealants, Hot Applied, Elastomeric, for Concrete and Asphalt Pavements
C. American Concrete Pavement Association (ACPA)
    1. ACPA Publication CP-01 – Repairing Concrete Pavements
D. Occupational Safety and Health Administration (OSHA)
    1. OSHA 29 CFR Part 1926 – Safety and Health Regulations for Construction

E. International Concrete Repair Institute (ICRI)
    1. ICRI Guideline No. 310.2R – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
F. Local and State Codes and Regulations
    1. Comply with all applicable local and state building codes, environmental regulations, and permitting requirements.

1.3 SUBMITTALS

A. Action Submittals
    1. Product Data: Submit manufacturer's technical data and installation instructions for repair materials, joint sealants, admixtures, curing compounds, and other products.
    2. Shop Drawings: Submit detailed repair plan including locations, extent of repair, joint details, and sequencing.
    3. Mix Designs: Submit proposed concrete repair mix design including admixtures, water-cement ratio, slump, and air content.
    4. Quality Control Plan: Submit procedures for quality control testing, inspection, and acceptance criteria.
    5. 1Safety Plan: Submit site-specific safety plan including hazard assessments and compliance with OSHA requirements.
B. Informational Submittals
    1. Manufacturer's Certificates: Provide certificates verifying compliance of materials with specified standards.
    2. Material Safety Data Sheets (MSDS): Submit MSDS for all chemical products used in repair.
    3. Test Reports: Submit results of pre-construction material tests and trial batch tests.
    4. Warranties: Submit sample warranties specified in paragraph 1.7.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Employ experienced installers specializing in concrete paving repair with minimum 5 years documented experience and successful completion of similar projects.
B. Testing Agency: Engage an independent testing agency to perform field and laboratory tests including concrete compressive strength, slump, air content, and cure verification.
C. Mock-Up: Construct a mock-up repair area approximately 100 square feet to demonstrate appearance, workmanship, and compatibility of materials. Approval required before proceeding.
D. Tolerances: Comply with ACI 117 tolerances for concrete repair thickness, surface finish, and joint alignment.

E. Environmental Conditions: Perform repairs within manufacturer-recommended ambient temperature and humidity ranges. Protect repair area from precipitation, freezing, and excessive heat during installation and curing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original unopened containers or packaging, clearly labeled with manufacturer's name, product identification, batch number, and expiration date.
B. Store cementitious materials in a dry, well-ventilated area protected from moisture and contamination.
C. Store admixtures and chemical products in accordance with manufacturer's instructions, maintaining recommended temperature ranges.
D. Handle all materials to prevent damage, contamination, and deterioration. Use sealed containers and protect from exposure to sun and weather.
E. Dispose of packaging and waste materials in accordance with applicable environmental regulations.

1.7 WARRANTIES

A. Provide manufacturer's standard warranty for repair materials covering defects in materials and workmanship for a minimum period of one year from date of acceptance.
B. Provide Contractor's warranty guaranteeing repair workmanship against defects for a minimum period of two years from date of acceptance.
C. Warranty shall include repair or replacement of defective work at no cost to the Owner.
D. Submit warranty documents prior to final acceptance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cementitious Repair Materials
    1. Use rapid-setting or standard-setting cementitious repair mortars complying with ASTM C928.
    2. Provide repair materials with compressive strength meeting or exceeding 4000 psi at 28 days.
    3. Use materials compatible with existing concrete substrate and environment.
B. Concrete
    1. Provide ready-mixed concrete complying with ASTM C94, with minimum 28-day compressive strength as specified in project documents.
    2. Use air-entrained concrete for freeze-thaw durability per ASTM C260.
C. Joint Sealants and Fillers
    1. Use preformed expansion joint filler complying with ASTM D1751.

2. Use hot-applied or cold-applied elastomeric joint sealants complying with ASTM D6690.

D. Admixtures
    1. Use admixtures complying with ASTM C494 as required for water reduction, set control, or air entrainment.

E. Curing Compounds
    1. Use curing compounds compatible with repair materials and meeting ASTM C309.

F. Aggregates
    1. Use aggregates conforming to ASTM C33 or project-specific grading requirements for repair mortar and concrete.

2.2 MANUFACTURERS

A. Cementitious Repair Materials
    1. Sika Corporation – SikaQuick Repair Mortars
    2. BASF Corporation – MasterEmaco S 488
    3. Euclid Chemical Company – Euco Repair
    4. Mapei Corporation – Planitop X

B. Joint Sealants and Fillers
    1. Pecora Corporation – Pecora 895
    2. D.S. Brown Company – D.S. Brown Joint Sealants
    3. Sonneborn – Sonolastic NP1

C. Concrete Admixtures
    1. GCP Applied Technologies – ADVA admixtures
    2. Sika Corporation – Sika admixtures

D. Curing Compounds
    1. Dayton Superior – Aquafilm
    2. Euclid Chemical Company – Euclid Cure & Seal

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify extent and locations of repair work with Contract Documents and site conditions.
B. Inspect existing concrete paving for cracks, spalls, joint distress, and surface defects.
C. Verify substrate is sound, clean, free of deleterious materials, loose particles, oils, and contaminants.
D. Confirm ambient and substrate temperatures are within limits prescribed by repair material manufacturers.

3.2 PREPARATION

A. Remove deteriorated concrete, unsound material, and loose debris by mechanical means such as chipping, grinding, or hydro-demolition.
B. Cut back repair edges to square or slightly beveled profiles to provide sound substrate and bonding surface.
C. Clean repair areas by abrasive blasting or high-pressure water blasting to achieve ICRI CSP 3-5 profile.
D. Remove all dust, dirt, and debris by vacuum or compressed air immediately prior to placement of repair materials.
E. Saturate concrete substrate with clean potable water to saturated surface dry (SSD) condition unless otherwise directed by manufacturer.

3.3 INSTALLATION OF REPAIR MATERIALS

A. Mix repair materials in accordance with manufacturer's instructions using approved mixing equipment.
B. Place repair material promptly after mixing to prevent premature setting.
C. Apply bonding agents or primers as recommended by repair material manufacturer.
D. Place repair material in layers not exceeding maximum thickness per manufacturer's recommendations.
E. Consolidate repair material thoroughly to eliminate voids and achieve full bond with substrate.
F. Finish surface to match existing adjacent pavement texture and elevation.
G. Protect repair area from traffic, precipitation, and temperature extremes during curing period.
H. Remove forms and perform joint repairs as specified after sufficient curing time.

3.4 JOINT REPAIR AND SEALING

A. Clean and prepare existing joints to receive new sealant or filler.
B. Replace or install new preformed joint fillers as required to restore joint function.
C. Apply joint sealants in strict accordance with manufacturer's instructions, ensuring proper joint width-to-depth ratio and tooling.
D. Protect joint sealants during cure period from contamination and damage.

3.5 FIELD QUALITY CONTROL

A. Conduct slump, air content, and temperature tests on concrete repair mixes at frequency specified by testing agency.
B. Cast and cure test cylinders for compressive strength testing at 7 and 28 days.
C. Monitor environmental conditions during placement and curing; record data for compliance verification.
D. Inspect finished repairs for surface defects, cracking, delamination, and adherence to tolerances.

E. Remove and replace repairs failing to meet quality standards at no additional cost.

3.6 PROTECTION

A. Protect repaired pavement from vehicular traffic and heavy loads until repair materials achieve specified strength and curing requirements.
B. Implement erosion and sediment control measures during and after repair work.
C. Maintain repair areas and adjacent surfaces free of debris and spilled materials.

3.7 CLEANING

A. Remove excess materials, debris, and equipment from site daily.
B. Clean all tools and equipment immediately after use.
C. Restore site conditions affected by repair work to original or better condition.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Section 31 20 00 – Earth Moving
B. Section 32 12 16 – Asphalt Paving
C. Section 32 13 13 – Concrete Paving
D. Section 32 14 13 – Asphaltic Concrete Paving
E. Section 32 91 23 – Turf and Grasses
F. Section 01 33 00 – Submittal Procedures
G. Section 01 45 00 – Quality Control
H. Section 01 78 00 – Closeout Submittals

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)
    1. AASHTO M 140 – Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses
    2. AASHTO T 99 – Moisture-Density Relations of Soils Using a 5.5-lb Rammer and 12-in. Drop
    3. AASHTO T 180 – Moisture-Density Relations of Soils Using a 10-lb Rammer and 18-in. Drop
    4. AASHTO T 27 – Sieve Analysis of Fine and Coarse Aggregates
    5. AASHTO T 88 – Particle Size Analysis of Soils
B. ASTM International (ASTM)
    1. ASTM D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3)
    2. ASTM D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)
    3. ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils
    4. ASTM D2487 – Classification of Soils for Engineering Purposes (Unified Soil Classification System)
    5. ASTM D2940 – Graded Aggregate Material for Bases or Subbases for Highways or Airports
C. Federal Highway Administration (FHWA)
    1. FHWA Technical Advisory T 5040.27 – Quality Assurance for Construction Materials Testing
D. Occupational Safety and Health Administration (OSHA)
    1. OSHA 29 CFR Part 1926 – Safety and Health Regulations for Construction

1.3 SUBMITTALS

A. Action Submittals
    1. Product Data: Submit manufacturers' technical data, including material compositions, physical properties, and installation instructions for aggregate base materials.
    2. Mix Design: Submit proposed aggregate gradation and mix design certified by a qualified testing laboratory.
    3. Quality Control Plan: Submit a detailed plan outlining testing procedures, frequency, and acceptance criteria for compaction and material quality.
    4. Samples: Submit representative samples of aggregate material in sizes specified for approval.
    5. Construction Schedule: Submit a schedule indicating anticipated start and completion dates of base course placement and compaction activities.
B. Informational Submittals
    1. Test Reports: Submit results of laboratory and field tests including gradation, compaction, moisture content, and density testing.
    2. Certifications: Submit certificates of compliance for materials used, including verification of aggregate source and compliance with specified standards.
    3. Inspection Reports: Submit inspection and monitoring reports documenting compliance with specified quality assurance requirements.

1.4 QUALITY ASSURANCE

A. Qualifications
    1. Installer Qualifications: Engage experienced installers with a minimum of five years documented experience in placing and compacting asphaltic base courses similar in material and scope to this project.
    2. Testing Laboratory: Use an independent testing agency qualified in performing soil and aggregate testing according to ASTM and AASHTO standards.
B. Pre-Installation Conference
    1. Conduct a pre-installation meeting to review project requirements, quality control procedures, and coordination with other trades.
C. Mock-Up
    1. Provide a mock-up section of base course not less than 100 square feet to demonstrate compliance with density, thickness, and surface tolerances.
D. Field Quality Control
    1. Conduct in-place density testing at a frequency not less than one test per 1,000 square yards or as required by the Engineer.
    2. Perform moisture content testing to ensure material is within optimum moisture range for compaction.
    3. Verify thickness and surface tolerances using approved measuring devices.
E. Nonconformance
    1. Remove and replace or rework base course material failing to meet specified requirements.

F. Regulatory Compliance
    1. Comply with all applicable federal, state, and local environmental, health, and safety regulations related to materials, handling, and placement.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery
    1. Deliver aggregate base materials in clean, dry condition, free of foreign materials or contaminants.
    2. Deliver materials in quantities and at times to avoid delays in construction.
B. Storage
    1. Stockpile aggregate materials on well-drained surfaces to prevent contamination or segregation.
    2. Protect materials from exposure to excessive moisture or freezing conditions.
C. Handling
    1. Handle materials to prevent segregation of particle sizes and contamination.
    2. Use equipment and methods that do not degrade the quality or gradation of aggregate base materials.

1.7 WARRANTIES

A. Material Warranty
    1. Provide a minimum one-year warranty for materials used in the base course from the date of substantial completion, ensuring they meet specified gradation and quality requirements.
B. Workmanship Warranty
    1. Provide a minimum one-year warranty for workmanship covering defects in placement, compaction, and adherence to thickness and density specifications.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Aggregate Base Course Material
    1. Aggregate base course shall consist of crushed stone, crushed slag, crushed gravel, or natural gravel conforming to ASTM D2940 and AASHTO M 140.
    2. Material shall be free from organic matter, clay lumps, or other deleterious substances.
    3. Gradation requirements:
        a) 100% passing 1-inch sieve
        b) 50-85% passing 3/8-inch sieve
        c) 25-60% passing No. 4 sieve
        d) 10-35% passing No. 200 sieve

4. Plasticity Index (PI) shall not exceed 6 as determined by ASTM D4318.

B. Water
    1. Water used for moisture conditioning and compaction shall be potable and free from harmful salts or impurities.

2.2 MANUFACTURERS

A. Aggregate Producers
    1. Vulcan Materials Company
    2. Martin Marietta Materials
    3. Oldcastle Materials
    4. Lehigh Hanson, Inc.
    5. Local approved quarry sources as verified by Engineer
B. Testing Agencies
    1. SGS North America
    2. Intertek Group plc
    3. Bureau Veritas
    4. Local state-certified laboratories

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is prepared in accordance with Section 31 20 00 – Earth Moving, with final grading complete and acceptable to Engineer.
B. Confirm that drainage provisions are in place and functioning to prevent water accumulation beneath base course.
C. Notify Engineer of unsatisfactory conditions prior to placement.

3.2 PREPARATION

A. Scarify and compact subgrade to minimum 95% of maximum dry density as determined by ASTM D698 or AASHTO T 99 unless otherwise specified.
B. Remove soft, unstable, or unsuitable materials and replace with approved fill.
C. Verify moisture content of subgrade is within ±2% of optimum for compaction.

3.3 PLACEMENT

A. Place aggregate base course in uniform layers not exceeding 8 inches loose thickness.
B. Spread material evenly using mechanical spreaders or approved equipment to avoid segregation.
C. Maintain moisture content within ±2% of optimum for maximum compaction during placement.

D. Compact each layer to at least 98% of maximum dry density as determined by ASTM D698 or AASHTO T 99.
E. Shape surface to required grade and cross-section with tolerance of ±0.1 foot in elevation and ±0.1 foot in lateral alignment.
F. Remove and replace any base course material that does not meet thickness, density, or moisture requirements.

3.4 FIELD QUALITY CONTROL

A. Testing
    1. Perform in-place density tests at a minimum frequency of one test per 1,000 square yards per layer or as directed by Engineer.
    2. Conduct moisture content tests at a minimum of one test per 500 square yards during placement.
    3. Submit test results to Engineer within 24 hours of testing.
B. Acceptance Criteria
    1. Minimum in-place density shall be 98% of laboratory maximum dry density.
    2. Thickness tolerance shall be within ±0.5 inches of design thickness per lift.
    3. Surface tolerance for finished base course shall not deviate more than 0.1 foot from specified grade.
C. Noncompliance
    1. Base course failing to meet specified density, thickness, or grading tolerances shall be removed and replaced or re-compacted to meet requirements.
    2. Additional testing shall be performed after corrective work.

3.5 PROTECTION

A. Protect completed base course from traffic, erosion, and contamination until subsequent paving or surfacing is placed.
B. Do not allow construction equipment to operate on base course unless approved by Engineer.
C. Repair damage resulting from construction operations at no additional cost.

3.6 CLEANING

A. Remove excess and waste materials from site in accordance with Section 01 74 19 – Construction Waste Management and Disposal.
B. Leave base course surface clean, uniform, and ready for subsequent construction.

END OF SECTION 32 11 26

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Asphalt paving for vehicular and pedestrian use.
   2. Asphalt binder courses and surface courses.
   3. Preparation of base and subbase for asphalt paving.
   4. Joint treatment and edge details.

B. Related Sections
   1. Division 31 – Earthwork
   2. Division 32 11 23 – Aggregate Base Courses
   3. Division 32 13 13 – Concrete Paving
   4. Division 32 17 23 – Pavement Markings
   5. Division 32 18 23 – Asphalt Millings and Recycled Asphalt
   6. Division 32 91 00 – Planting and Ground Cover
   7. Division 01 – General Requirements and Coordination

1.2 REFERENCES, CODES, AND STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)
   1. AASHTO M 292 – Standard Specification for Performance-Graded Asphalt Binder
   2. AASHTO T 85 – Specific Gravity of Bituminous Materials
   3. AASHTO T 308 – Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method

B. ASTM International
   1. ASTM D946 – Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
   2. ASTM D1559 – Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
   3. ASTM D2041 – Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
   4. ASTM D3381 – Standard Test Method for Viscosity of Asphalt Materials
   5. ASTM D4867 – Standard Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)
   6. ASTM D6926 – Standard Test Method for Asphalt Binder Content of Hot Mix Asphalt by Ignition Method

C. National Asphalt Pavement Association (NAPA)
   1. NAPA Quality Control/Quality Assurance Guidelines for Hot Mix Asphalt

D. Asphalt Institute
   1. MS-2 – Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types
   2. MS-19 – Asphalt Pavement Construction

E. Federal Highway Administration (FHWA)
    1. FHWA-HIF-12-003 – Hot Mix Asphalt Pavement Construction Best Practices
F. Occupational Safety and Health Administration (OSHA) Standards
G. Local and State Department of Transportation (DOT) Standards, as applicable

1.3 DEFINITIONS

A. Asphalt Binder: The bituminous material used to bind aggregate particles in asphalt concrete.
B. Hot Mix Asphalt (HMA): A mixture of aggregate and asphalt binder heated and mixed at elevated temperatures for paving applications.
C. Tack Coat: A light application of asphalt emulsion applied between pavement layers to promote bond.
D. Prime Coat: An application of low viscosity asphalt to an unbound base layer to improve bonding with the asphalt surface.
E. Lift: A single layer of asphalt paving placed during one operation.

1.4 SUBMITTALS

A. Action Submittals
    1. Product Data: Manufacturer's technical data sheets for asphalt binder, emulsions, additives, and paving materials.
    2. Mix Design: Submit proposed hot mix asphalt mix design including gradation, binder content, air voids, and performance properties certified by a qualified laboratory.
    3. Quality Control Plan: Detailed plan outlining procedures for mix production, testing frequency, paving operations, and acceptance criteria.
    4. Equipment List: Identification and description of paving, compaction, and testing equipment.
    5. Construction Schedule: Proposed schedule for paving operations including weather and temperature considerations.
    6. Certifications: Asphalt binder certification confirming compliance with specified performance grades and material properties.
B. Informational Submittals
    1. Test Reports: Laboratory test results verifying compliance of materials and mix design with specified requirements.
    2. Field Quality Control Reports: Documentation of on-site testing during paving operations.
    3. Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Paving Contractor shall have a minimum of five years' experience in asphalt paving of similar scope and magnitude.

B. Testing laboratory shall be accredited and experienced in hot mix asphalt testing.
C. Testing and Inspection:
    1. Materials shall be tested per ASTM and AASHTO standards referenced.
    2. Field density and compaction testing to be performed using nuclear density gauge or core sampling as per project requirements.
    3. Continuous monitoring of temperature during production and placement to meet specification limits.
D. Mock-Up:
E. Provide a test strip or mock-up of paving to demonstrate finish, compaction, and joint treatment acceptable to the Architect/Engineer prior to full-scale paving.
F. Compliance:
    1. All work shall comply with applicable local, state, and federal regulations governing asphalt paving.
G. Environmental Requirements:
    1. Asphalt paving shall not be performed when ambient temperature is below manufacturer's recommended limits or when weather conditions could impair quality.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
    1. Deliver asphalt binder and emulsions in manufacturer's original, unopened containers with labels intact.
    2. Hot mix asphalt shall be delivered promptly to maintain temperature and workability.
B. Storage:
    1. Store asphalt binder and emulsions in temperature-controlled facilities to prevent degradation.
    2. Aggregate stockpiles shall be maintained free from contamination and segregation.
C. Handling:
    1. Handle all materials to prevent contamination and damage.
    2. Use approved equipment for loading, transport, and placement of hot mix asphalt.

1.7 WARRANTY

A. Provide a warranty for the asphalt paving materials and workmanship for a period of not less than one year from date of substantial completion.
B. Warranty shall cover defects such as cracking, rutting, delamination, and premature failure not due to normal wear or structural deficiencies in underlying base.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphalt Binder:
    1. Performance Grade (PG) binder shall comply with AASHTO M 292 and ASTM D946. Typical grade: PG 64-22 or as specified.
    2. Binder shall be free of contaminants and meet viscosity and penetration requirements.
B. Aggregates:
    1. Aggregates shall comply with ASTM C33 or local DOT gradation requirements.
    2. Aggregates shall be clean, hard, durable, and free of deleterious materials.
C. Hot Mix Asphalt (HMA):
    1. Mix design shall conform to Asphalt Institute MS-2 mix design methods.
    2. Mixture gradation and binder content shall comply with project-specific requirements.
    3. Air void content shall be between 3% and 5% after compaction.
D. Tack Coat:
    1. Use SS-1h or CSS-1h asphalt emulsions conforming to ASTM D2397.
E. Prime Coat:
    1. Use low viscosity asphalt materials conforming to ASTM D2027 or local DOT standards.
F. Additives and Modifiers:
    1. Additives such as anti-stripping agents may be used as approved.
G. Joint Sealants:
    1. Use hot-pour rubberized asphalt sealants or as specified for longitudinal and transverse joints.

2.2 MANUFACTURERS

A. Asphalt Binder Suppliers:
    1. Valero Energy Corporation
    2. NuStar Energy L.P.
    3. Marathon Petroleum Corporation
B. Hot Mix Asphalt Producers:
    1. Granite Construction Inc.
    2. Vulcan Materials Company
    3. Martin Marietta Materials
C. Asphalt Emulsion Suppliers:
    1. Ergon Asphalt & Emulsions, Inc.
    2. McAsphalt Industries Limited
D. Additive Suppliers:
    1. BASF Corporation

2. Evonik Industries AG

E. Joint Sealant Manufacturers:
    1. Crafco, Inc.
    2. Sonneborn, a BASF company

2.3 EQUIPMENT

A. Paving Equipment:
    1. Self-propelled asphalt pavers capable of placing uniform lifts at specified widths and thicknesses.
B. Compaction Equipment:
    1. Steel-wheeled rollers and pneumatic-tired rollers suitable for effective compaction of HMA.
C. Temperature Measuring Devices:
    1. Infrared or contact thermometers for verifying mix and pavement temperatures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that base and subbase courses have been installed and compacted to required tolerances and densities.
B. Confirm that drainage and grading are complete and conform to project drawings.
C. Notify Architect/Engineer of unsatisfactory conditions before proceeding.

3.2 PREPARATION

A. Clean base surfaces of dust, dirt, loose materials, and debris.
B. Apply prime coat to unbound base if specified, and allow curing as recommended.
C. Apply tack coat to existing asphalt surfaces or between lifts as specified.

3.3 INSTALLATION

A. Hot Mix Asphalt Production:
    1. Produce HMA at temperatures recommended by manufacturer, typically between 275°F and 325°F.
    2. Maintain uniform mixing and delivery to paving site.
B. Paving:
    1. Place asphalt mix in layers not exceeding specified lift thickness (typically 2 to 3 inches).
    2. Spread and strike off mix uniformly to required grade and slope.
C. Compaction:
    1. Begin compaction immediately after paving while mix is still hot.

2. Achieve density not less than 92% of maximum theoretical density determined by ASTM D2041.
3. Use multiple roller passes with steel and pneumatic rollers to achieve uniform compaction.

D. Joints:
1. Construct longitudinal and transverse joints to provide a smooth, continuous surface.
2. Treat joints with tack coat prior to adjoining lift placement.
3. Seal joints with specified joint sealant after compaction.

E. Surface Finish:
1. Surface shall be smooth, free of segregation, and compacted uniformly.
2. Correct irregularities exceeding 1/4 inch in 10 feet.

3.4 FIELD QUALITY CONTROL

A. Testing Frequency:
1. Perform gradation and binder content tests on mix samples at a minimum frequency of one test per 500 tons or as specified.
2. Conduct density tests on paved lifts at intervals not less than one test per 1,000 square yards.

B. Temperature Monitoring:
1. Record mix and pavement temperature at start, during, and at completion of paving.

C. Acceptance Criteria:
1. Mix properties and compaction must comply with specified tolerances.
2. Reject and remove paving not conforming to requirements.

3.5 PROTECTION AND CLEANUP

A. Protect newly placed asphalt from traffic and adverse weather for minimum curing period specified by manufacturer.
B. Remove excess materials, debris, and equipment from site upon completion.
C. Repair any damage to adjacent surfaces or structures caused by paving operations.

3.6 MAINTENANCE

A. Maintain asphalt pavement in good condition for duration of warranty period.
B. Perform crack sealing, patching, and surface treatments as required to preserve pavement integrity.

END OF SECTION

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, but are not limited to:
    1. Section 01 33 00 - Submittal Procedures
    2. Section 01 45 00 - Quality Control
    3. Section 01 60 00 - Product Requirements
    4. Section 03 30 00 - Cast-in-Place Concrete
    5. Section 31 20 00 - Earth Moving
    6. Section 32 11 23 - Aggregate Base Courses
    7. Section 32 92 00 - Turf and Grasses
    8. Section 32 17 23 - Concrete Curbs and Sidewalks

1.2 REFERENCES, CODES AND STANDARDS

A. American Concrete Institute (ACI)
    1. ACI 301 - Specifications for Structural Concrete
    2. ACI 302.1R-04 - Guide for Concrete Floor and Slab Construction
    3. ACI 305R - Hot Weather Concreting
    4. ACI 306R - Cold Weather Concreting
B. American Society for Testing and Materials (ASTM)
    1. ASTM C33 - Specification for Concrete Aggregates
    2. ASTM C94/C94M - Specification for Ready-Mixed Concrete
    3. ASTM C143/C143M - Test Method for Slump of Hydraulic-Cement Concrete
    4. ASTM C150/C150M - Specification for Portland Cement
    5. ASTM C157/C157M - Test Method for Length Change of Hardened Hydraulic-Cement Concrete
    6. ASTM C172 - Practice for Sampling Freshly Mixed Concrete
    7. ASTM C260 - Specification for Air-Entraining Admixtures for Concrete
    8. ASTM C494/C494M - Specification for Chemical Admixtures for Concrete
    9. ASTM C595/C595M - Specification for Blended Hydraulic Cements
    10. ASTM C618 - Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
    11. ASTM C682 - Test Method for Length Change of Concrete Due to Alkali-Silica Reaction
    12. ASTM C642 - Test Method for Density, Absorption, and Voids in Hardened Concrete
C. American Association of State Highway and Transportation Officials (AASHTO)
    1. AASHTO M 85 - Standard Specification for Portland Cement

2. AASHTO M 145 - Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

D. Portland Cement Association (PCA)
E. U.S. Green Building Council (USGBC)
F. Occupational Safety and Health Administration (OSHA)
    1. OSHA 29 CFR 1926 - Safety and Health Regulations for Construction

1.3 QUALITY ASSURANCE

A. Perform concrete paving work in accordance with ACI 301 and ACI 302.1R and other referenced standards.
B. Concrete mix design shall be developed and approved by a qualified testing agency experienced in concrete paving.
C. Testing laboratory shall be independent and certified in accordance with ASTM C1077 and ASTM E329.
D. Installer qualifications: Experienced in similar concrete paving projects with documented successful installations.
E. Mock-up: Provide a mock-up panel of concrete paving, minimum 100 square feet, to demonstrate surface finish, jointing, and coloration.
F. Conduct pre-paving conference to review procedures, quality control, and safety measures.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's technical data for cementitious materials, admixtures, curing compounds, joint fillers, and sealers.
B. Mix Designs: Submit proposed concrete mix designs including materials, proportions, and admixtures with supporting test data.
C. Samples: Submit physical samples of curing compounds, joint sealants, and surface finish treatments.
D. Shop Drawings: Submit layout drawings showing joint spacing, patterns, thickness, reinforcement, and edge treatments.
E. Certificates: Submit certification of compliance for cement, aggregates, admixtures, and other materials as specified.

1.5 INFORMATIONAL SUBMITTALS

A. Test Reports: Submit test reports for aggregates, cementitious materials, and trial batch concrete.
B. Installation Instructions: Manufacturer’s recommended installation instructions for products used in concrete paving.
C. Maintenance Data: Submit maintenance instructions for concrete paving, including cleaning and repair.

D. Warranties: Submit manufacturer and installer warranties as specified.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver cement, aggregates, admixtures, and other materials in original unopened containers with labels intact.
B. Store cement and cementitious materials in a dry, moisture-proof area. Protect from contamination and moisture damage.
C. Store aggregates to prevent segregation, contamination, and moisture accumulation.
D. Store admixtures in accordance with manufacturer's recommendations and protect from freezing or overheating.
E. Handle materials to prevent damage or contamination. Use equipment and methods to prevent segregation or loss of materials.

1.7 WARRANTY

A. Provide a minimum 1-year warranty on concrete paving against defects in materials and workmanship from date of final acceptance.
B. Provide manufacturer’s warranties on chemical admixtures, curing compounds, sealants, and other proprietary materials as applicable.
C. Warranty shall include repair or replacement of defective paving including removal and replacement of unsatisfactory concrete.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150, Type I or II, or ASTM C595 blended hydraulic cement as approved.
B. Aggregates: ASTM C33, clean, hard, durable, and graded aggregates. Coarse and fine aggregates free of deleterious substances.
C. Water: Clean, potable, free from impurities that may affect setting, strength or durability.
D. Admixtures: ASTM C494 compliant chemical admixtures, including water reducers, air-entraining agents, retarders, and accelerators as required.
E. Reinforcement: If required, use welded wire fabric or steel reinforcing bars conforming to ASTM A615 or ASTM A1064.
F. Joint Materials:
    1. Joint Fillers: ASTM D1751 bituminous fiber expansion joint fillers or preformed elastomeric joint fillers.
    2. Joint Sealants: Polyurethane or silicone sealants compatible with concrete, ASTM C920 compliant.
G. Curing Compounds: ASTM C309, clear or translucent, designed for curing concrete pavements.

H. Surface Finishes: Broom finish or as indicated on drawings.
I. Subbase and Base Materials: As specified in Section 32 11 23 - Aggregate Base Courses.

2.2 MANUFACTURERS

A. 2.2.1 Cement and Admixtures:
    1. LafargeHolcim
    2. CEMEX
    3. BASF Construction Chemicals
    4. Sika Corporation
B. Aggregates:
    1. Local approved quarries or suppliers meeting ASTM C33 requirements.
C. Joint Fillers and Sealants:
    1. W.R. Meadows
    2. Pecora Corporation
    3. Sonneborn (Grace Construction Products)
D. Curing Compounds:
    1. Euco (Euclid Chemical Company)
    2. W.R. Meadows
E. Reinforcement:
    1. Nucor Steel
    2. CMC Rebar

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that subgrade and base course have been installed and compacted to required density and tolerances.
B. Ensure that subgrade is free of soft spots, debris, frost, or frozen material.
C. Verify layout, elevations, and grades are established and conform to drawings and specifications.
D. Notify Architect/Engineer of any conditions detrimental to quality or performance of concrete paving. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Grade and compact subgrade and base course in accordance with Section 31 20 00 and Section 32 11 23.
B. Moisten subgrade and base to uniform dampness without standing water immediately before placing concrete.
C. Set and secure forms to lines and grades with adequate strength to withstand concrete placement and finishing operations.

D. Provide joint layout and insert joint materials as specified.

3.3 CONCRETE MIXING AND DELIVERY

A. Mix concrete in accordance with ASTM C94 and approved mix designs.
B. Maintain slump between 3 and 5 inches unless otherwise directed.
C. Use air-entrained concrete with air content between 5% and 8% for freeze-thaw durability.
D. Deliver concrete to site promptly and discharge into forms or placing equipment without segregation.
E. During hot or cold weather, comply with ACI 305R and ACI 306R respectively.

3.4 PLACING CONCRETE

A. Place concrete continuously between expansion joints to prevent cold joints.
B. Deposit concrete as close as possible to final position to minimize segregation.
C. Consolidate concrete with internal vibrators without over-vibration.
D. Screed to grade and strike off to produce a uniform surface.
E. Perform initial surface finishing as soon as bleed water disappears, using bull float or darby.

3.5 JOINTING

A. Install contraction joints at maximum spacing of 15 feet or as indicated on drawings.
B. Form joints with saw-cut or formed joints as approved.
C. Install expansion joints at intervals indicated on drawings with compressible filler.
D. Seal joints with approved sealant after curing period, ensuring joints are clean and dry.

3.6 FINISHING

A. Apply broom finish perpendicular to traffic direction for slip resistance.
B. Edges: Round edges with edging tool to 1/4 inch radius unless otherwise indicated.
C. Remove surface defects and repair minor imperfections immediately.

3.7 CURING

A. Begin curing immediately after finishing operations.
B. Use curing compound applied uniformly at manufacturer’s recommended rate.
C. Alternatively, use wet curing methods such as wet burlap or polyethylene sheeting for a minimum of 7 days.
D. Protect concrete from rapid moisture loss, freezing, rain, and contamination during curing period.

3.8 PROTECTION AND CLEANING

A. Protect newly placed concrete from traffic and construction loads until it attains sufficient strength.
B. Remove forms and joint filler carefully without damaging concrete edges.
C. Clean concrete surfaces of stains, dirt, and curing residues using methods approved by Architect/Engineer.
D. Repair or replace defective or damaged concrete paving as directed.

3.9 FIELD QUALITY CONTROL

A. Testing Agency Responsibilities:
    1. Perform slump tests, air content, temperature, and casting of test specimens in accordance with ASTM C172, ASTM C143, and ASTM C231.
    2. Test concrete compressive strength at 7 and 28 days per ASTM C39.
    3. Perform additional tests as required to verify compliance with mix design and performance criteria.
B. Monitor joint spacing, depth, and sealant installation for compliance.
C. Document all quality control tests and submit reports promptly.

3.10 REPAIRS AND PATCHING

A. Repair minor surface defects with approved patching mortar compatible with existing concrete.
B. For major defects or failures, remove defective concrete and replace with new concrete as specified.
C. Ensure repairs match adjoining concrete in finish, texture, and color.

3.11 MAINTENANCE

A. Clean concrete paving periodically with water and mild detergents.
B. Inspect and maintain joint sealants to prevent infiltration of water and debris.
C. Repair surface damage promptly to maintain durability and appearance.

END OF SECTION 32 13 13

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 but are not limited to:
   1. Section 31 20 00 – Earth Moving
   2. Section 31 23 00 – Excavation and Fill
   3. Section 32 13 13 – Soil Preparation
   4. Section 32 93 00 – Planting
   5. Section 32 90 00 – Planting Irrigation
   6. Section 33 11 00 – Water Utility Distribution Piping

1.2 SUMMARY

A. This Section includes furnishing and installing turf and grasses including:
   1. Preparation of seedbeds and soil amendments.
   2. Installation of turf by seeding, sodding, or hydroseeding.
   3. Fertilizing, watering, and initial maintenance.
B. Related requirements include:
   1. Soil testing and analysis (Section 32 13 13).
   2. Irrigation for turf establishment (Section 32 90 00).

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM D2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
   2. ASTM D5268 – Standard Practice for Topsoil Fines Assessment
B. American Association of Nurserymen (AAN)
   1. AAN Z60.1 – Nursery Stock Standards
C. American Society of Agronomy (ASA)
D. Federal Seed Act (FSA)
E. International Code Council (ICC)
   1. International Building Code (IBC)
F. Turfgrass Producers International (TPI)
G. U.S. Department of Agriculture (USDA)
H. U.S. Green Building Council (USGBC)

1.4 DEFINITIONS

A. Turf: A surface layer of earth containing a dense growth of grass and its matted roots.
B. Seedbed: Prepared soil surface to receive grass seed or sod.
C. Hydroseeding: Application of seed, mulch, fertilizer, and water in a slurry by spraying.
D. Sodding: Installation of pre-grown turf cut into sections.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Engage an experienced installer who has successfully completed turf and grass installation similar in scope and quality to this project.
   2. Installer shall be a member of Turfgrass Producers International or similar professional turf association.
B. Source Quality:
   1. Obtain seed and sod from sources with a minimum of 5 years' experience growing and supplying turf materials in the project region.
   2. Provide seed and sod that comply with applicable state and federal regulations.
C. Regulatory Requirements:
   1. Comply with Federal Seed Act and applicable state seed laws regarding seed labeling, purity, and germination.
   2. Comply with local codes including International Building Code requirements for erosion and sediment control related to turf installation.
D. Testing and Verification:
   1. Soil Testing: Perform soil analysis prior to seeding or sodding to determine pH, nutrient levels, and organic matter content.
   2. Seed Testing: Provide seed test reports including purity, germination percentage, noxious weed seed content, and date of testing.

1.6 SUBMITTALS

A. Action Submittals:
   1. Product Data: For all turf materials including seed mixes, sod, fertilizers, and soil amendments.
   2. Samples:
      (1) Provide representative samples of seed mix, minimum 100 grams.
      (2) Provide sod sample, minimum 12 inches by 12 inches.
   3. Shop Drawings: Layout plan showing areas of turf installation, seed mix types, and installation methods.
   4. Certificates: Certification of seed analysis and sod source.
   5. Manufacturer's Installation Instructions for each product.
B. Informational Submittals:
   1. Soil Test Reports.
   2. Turf Establishment Plan including watering schedule, fertilization plan, and maintenance procedures.
   3. Maintenance Data including instructions for maintenance during warranty period.
   4. Warranty Documentation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Deliver seed in original sealed containers with labels intact indicating species, purity, germination rates, and testing date.
   2. Deliver sod fresh, cut within 24 hours prior to delivery, and maintain moisture during transport.

B. Storage:
    1. Store seed in a cool, dry location protected from sunlight, moisture, and pests.
    2. Store sod on pallets or similar supports to prevent contamination and moisture loss.
C. Handling:
    1. Handle seed and sod carefully to prevent damage or contamination.
    2. Protect soil and seedbeds from compaction and contamination prior to installation.

1.9 WARRANTY

A. Provide a minimum 12-month warranty on turf and grasses covering establishment and maintenance.
B. Warranty shall cover replacement or repair of turf that fails to thrive due to installation or material defects, including failure to meet specified density, uniformity, and coverage criteria.
C. Provide manufacturer's standard warranty for seed and sod materials.
D. Provide installer's warranty covering workmanship for the duration of the maintenance period.

PART 2 – PRODUCTS

2.1 TURFGRASS SEED

A. Seed Mix: Provide seed mix as indicated on drawings and specified in contract documents.
B. Species and Varieties: Use only species and cultivars adapted to local climate and soil conditions.
C. Seed Purity and Germination:
    1. Minimum purity 95% by weight.
    2. Minimum germination 80% for all species.
D. Noxious Weed Seed Content: Comply with Federal and State regulations; maximum 0.01% by weight.
E. Seed Analysis Report: Submit current seed test analysis with each shipment.

2.2 TURFGRASS SOD

A. Sod Type: Provide sod of species and cultivars specified in contract documents.
B. Quality:
    1. Sod shall be free of weeds, diseases, and pests.
    2. Sod thickness shall be 1 to 1.5 inches including soil and root mat.
    3. Sod shall be harvested within 24 hours prior to installation.
C. Source: Use sod grown in similar climatic and soil conditions to project site.
D. Moisture Content: Sod must be moist at delivery and maintained until installation.

2.3 SOIL AMENDMENTS

A. Fertilizers:
    1. Provide commercial fertilizers conforming to ASTM standards and state regulations.
    2. Use slow-release nitrogen fertilizers with minimum analysis of 10-10-10 or as specified.
B. Organic Matter:
    1. Provide composted organic matter free of contaminants, weed seeds, and pathogens.
C. Lime and pH Adjusters:

1. Provide agricultural lime or other pH adjusting materials as required by soil tests.

2.4 MULCH MATERIALS

A. Provide straw mulch or other approved erosion control mulch to protect seeded areas.
B. Mulch shall be free of noxious weeds and contaminants.

2.5 WATER

A. Provide potable water for irrigation and establishment of turf.

2.6 MANUFACTURERS

A. Turfgrass Producers:
   1. Scotts Miracle-Gro Company
   2. Pennington Seed, Inc.
   3. Jonathan Green, Inc.
   4. Berger Seeds
   5. Sun City Turf, LLC
B. Fertilizer Manufacturers:
   1. The Andersons, Inc.
   2. Haifa Group
   3. Lesco, Inc.
C. Soil Amendment Suppliers:
   1. Black Kow Compost
   2. Earthgro Compost
   3. Local approved compost suppliers

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that soil preparation, grading, and drainage work are complete and conform to requirements.
B. Verify that soil pH and nutrient levels comply with recommendations from soil testing.
C. Do not proceed with turf installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Seedbed Preparation:
   1. Loosen soil to minimum 4 inches depth using tilling or rototilling equipment.
   2. Remove debris, stones larger than 1 inch, roots, and other materials that may interfere with turf growth.
   3. Incorporate soil amendments and fertilizers as recommended by soil test results.
   4. Grade and smooth seedbed to eliminate low spots and provide positive drainage.
   5. Lightly compact seedbed surface to firm but not hard condition.
B. Sod Bed Preparation:

1. Prepare soil as for seedbed preparation.
2. Ensure smooth and firm surface to receive sod with no voids.

3.3 INSTALLATION

A. 3.3.1 Seeding:
   1. Apply seed at rates specified by manufacturer or contract documents.
   2. Use mechanical spreaders for uniform distribution.
   3. Lightly rake or drag seeded area to incorporate seed into soil 0.25 to 0.5 inches deep.
   4. Apply mulch immediately after seeding to protect seed and retain moisture.
B. Hydroseeding (If Specified):
   1. Prepare slurry of seed, fertilizer, mulch, tackifier, and water per manufacturer's instructions.
   2. Apply slurry uniformly with hydroseeding equipment at specified rates.
C. Sodding:
   1. Lay sod in staggered rows with tight joints; avoid gaps or overlapping.
   2. Roll sod immediately after installation to ensure contact with soil.
   3. Trim sod edges neatly and fill voids with soil or sod pieces.
D. Fertilization:
   1. Apply starter fertilizer at installation as recommended by soil test.
E. Watering:
   1. Begin watering immediately after installation to maintain soil moisture adequate for germination and establishment.
   2. Follow watering schedule as per Turf Establishment Plan.

3.4 FIELD QUALITY CONTROL

A. Inspection:
   1. Inspect turf areas weekly during establishment for coverage, density, and weed invasion.
   2. Identify and correct areas of poor growth or damage.
B. Acceptance Criteria:
   1. Turf shall be healthy, uniformly dense, free of bare or thin spots greater than 5% of any area.
   2. Weeds shall not exceed 10% of turf area by visual estimate.

3.5 MAINTENANCE

A. Provide maintenance for minimum 12 months after installation including watering, mowing, fertilization, weed control, and pest management.
B. Maintain turf at height recommended by species and cultivar guidelines.
C. Repair or replace areas failing to meet requirements at no additional cost to Owner.

3.6 CLEANING

A. Remove debris, excess soil, and materials from turf areas after installation and maintenance operations.
B. Leave the site in a clean and orderly condition acceptable to the Owner.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Division 01 - General Requirements
B. 31 20 00 - Earth Moving
C. 32 13 13 - Concrete Paving
D. 32 84 00 - Irrigation
E. 32 91 00 - Planting Preparation
F. 32 92 00 - Lawns and Grasses
G. 32 94 00 - Planting Irrigation
H. 33 11 00 - Water Utilities
I. 01 33 00 - Submittal Procedures
J. 01 45 00 - Quality Control

1.2 REFERENCES, STANDARDS, AND CODES

A. American National Standards Institute (ANSI)
    1. ANSI Z60.1 - American Standard for Nursery Stock
B. American Society for Testing and Materials (ASTM)
    1. ASTM D5268 - Standard Guide for Planting Design and Installation
    2. ASTM D5970 - Standard Guide for Nursery Stock Quality
C. American Society of Landscape Architects (ASLA)
D. International Society of Arboriculture (ISA)
E. U.S. Department of Agriculture (USDA) Plant Hardiness Zone Map
F. Occupational Safety and Health Administration (OSHA) Standards
G. Local Municipal Codes and Ordinances
H. ANSI A300 - Tree Care Operations - Tree, Shrub, and Other Woody Plant Maintenance Standards
I. ANSI Z133 - Safety Requirements for Arboricultural Operations

1.3 DEFINITIONS

A. Plants - Includes trees, shrubs, ground covers, vines, grasses, and perennials specified for the project.
B. Nursery Stock - Plants grown and maintained under specified standards for transplanting.
C. Planting Soil - Soil or planting medium prepared or amended for plant installation.

1.4 QUALITY ASSURANCE

A. All plants shall conform to ANSI Z60.1 standards for nursery stock size, quality, and grading.
B. Plants shall be nursery grown, healthy, vigorous, and free of disease, pests, and defects.

C. Inspection of plants may be performed by an independent certified arborist or landscape architect prior to delivery and installation.
D. Plant installation shall comply with ANSI A300 standards and local regulations.
E. Contractor shall maintain all plants in a healthy, growing condition from time of delivery through final acceptance.
F. Provide evidence of compliance with applicable codes and standards upon request.

1.5 SUBMITTALS

A. Action Submittals
    1. Plant List - Submit a complete list of plants including botanical and common names, quantities, sizes, and source nurseries.
    2. Samples - Submit representative samples of plant tags, labels, and root ball wrapping materials.
    3. Planting Schedule - Detailed schedule indicating installation sequence and timing.
    4. Manufacturer's Data - For all planting materials, amendments, and protective devices.
    5. Maintenance Schedule - Provide detailed maintenance instructions including watering, fertilizing, pruning, and inspection.
B. Informational Submittals
    1. Certification of compliance with ANSI Z60.1 and other applicable standards.
    2. Warranty documentation.
    3. Inspection reports from certified arborist or landscape architect.
    4. Material safety data sheets (MSDS) for fertilizers, pesticides, and soil amendments.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver plants in a healthy condition with root balls or containers intact, securely wrapped and labeled.
B. Protect plants from damage during transportation; avoid exposure to excessive heat, cold, or drying winds.
C. Store plants in a shaded, well-ventilated area with adequate moisture until installation.
D. Maintain adequate watering and protection against mechanical damage, pests, and disease during storage.
E. Handle plants by root ball or container only; do not lift by trunk, stems, or branches.

1.7 WARRANTY

A. Provide a minimum warranty period of one (1) year from date of final acceptance.
B. Warranty shall cover replacement or restoration of plants that fail to thrive, die, or become severely damaged.

C. Warranty shall include labor, materials, and maintenance necessary for replacement plants.
D. Contractor shall guarantee plant establishment and health during the warranty period.
E. Warranty does not cover damage caused by acts of God, vandalism, or neglect by the Owner.

PART 2 – PRODUCTS

2.1 PLANTS

A. General Requirements
    1. Provide plants that conform to the sizes, species, and quantities specified on the drawings and in the plant list.
    2. All plants shall be nursery grown, acclimated to local climate, and free from disease, pests, and mechanical injury.
    3. Plants shall have well-developed branch and root systems.
B. Trees
    1. Provide trees meeting or exceeding ANSI Z60.1 size and quality requirements for specified caliper or height.
    2. Root balls shall be wrapped in burlap or wire basket unless otherwise specified.
C. Shrubs and Ground Covers
    1. Provide container-grown or balled and burlapped stock with healthy root systems.
D. Vines and Climbers
    1. Provide plants suitable for site conditions and support structures specified.
E. Grasses and Perennials
    1. Provide plants grown in containers or plugs, acclimated to site conditions.

2.2 SOILS AND AMENDMENTS

A. Planting Soil
    1. Provide planting soil mix complying with project soil analysis recommendations.
    2. Mix shall be free of debris, toxic substances, and foreign matter.
B. Soil Amendments
    1. Provide organic compost, peat moss, sand, or other amendments as specified.
    2. Amend soil to improve texture, drainage, fertility, and pH as recommended by soil tests.

2.3 MULCHES

A. Provide organic mulch such as shredded bark, wood chips, or pine needles.
B. Mulch shall be free of weed seeds, toxic materials, and shall comply with local regulations.
C. Apply mulch uniformly at specified depth.

2.4 FERTILIZERS AND PLANTING AIDS

A. Provide fertilizers formulated for new planting applications with slow-release characteristics.
B. Provide mycorrhizal inoculants, soil conditioners, or other planting aids as specified.

2.5 PLANT PROTECTION DEVICES

A. Provide tree stakes, guying, wrapping, and guards as needed to protect plants during and after installation.
B. Materials shall be durable, weather-resistant, and non-damaging to plants.

2.6 MANUFACTURERS

A. Plants and Materials Suppliers
    1. Proven Winners®
    2. Monrovia Nursery Company
B. Frank Schmidt & Son Co.
    1. Ball Horticultural Company
    2. Arbor Day Foundation Nurseries
    3. Local Certified Native Plant Nurseries (as approved)
C. Soil Amendments and Fertilizers
    1. Espoma Organic Products
    2. Scotts Miracle-Gro Company
    3. BioTerra Soil Products
D. Mulches
    1. Northwest Bark
    2. Pine Bark Nuggets Inc.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that grading, drainage, and irrigation systems are completed and functional prior to planting.
B. Inspect planting areas for compliance with specified soil preparation requirements.
C. Notify Architect or Landscape Architect of any discrepancies or conditions detrimental to plant growth.

3.2 PREPARATION

A. Prepare planting soil as specified in Section 32 91 00 - Planting Preparation.

B. Loosen subgrade and incorporate soil amendments thoroughly.
C. Verify moisture content of planting soil is adequate for planting operations.

3.3 PLANT INSTALLATION

A. Planting Procedures
    1. Plant trees, shrubs, and other plants in accordance with ANSI Z60.1 and ASTM D5268 guidelines.
    2. Dig holes large enough to accommodate root systems without crowding or deformation.
    3. Place plants plumb and at proper depth; backfill with amended planting soil.
    4. Water plants thoroughly after planting to eliminate air pockets.
B. Tree Installation
    1. Remove wire baskets and burlap from root balls as much as possible without disturbing roots.
    2. Stake and guy trees as required to provide stability.
C. Shrub, Ground Cover, and Perennial Installation
    1. Space plants as indicated on drawings and per nursery recommendations.
    2. Firm soil around roots to ensure good contact without compaction.
D. Mulching
    1. Apply mulch in planting beds and around trees to specified depth, avoiding direct contact with stems or trunks.
E. Fertilization
    1. Apply starter fertilizer in planting holes or as top dressing per manufacturer's instructions.

3.4 PLANT PROTECTION AND MAINTENANCE

A. Protect plants from damage due to construction activities, pests, and environmental extremes.
B. Provide temporary watering and irrigation as required to establish plants.
C. Prune plants only as necessary to remove dead or damaged parts; do not over-prune.
D. Maintain plants in a healthy growing condition until final acceptance.
E. Remove all planting debris and unused materials from site.

3.5 FINAL ACCEPTANCE

A. Final inspection will occur after the warranty period to verify plant health and establishment.
B. Replace plants that have died or failed to thrive as specified in the warranty.
C. Provide documentation of maintenance and replacement activities.

End of Section

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PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Division 01 – General Requirements
B. Section 31 23 00 – Excavation and Fill
C. Section 31 23 33 – Trenching
D. Section 33 46 00 – Subdrainage Systems
E. Section 33 46 13 – Storm Drainage Piping and Appurtenances
F. Section 33 05 13 – Common Work Results for Utilities
G. Section 31 05 16 – Geotextiles
H. Section 32 13 13 – Concrete Paving
I. Section 33 11 00 – Water Utilities
J. Section 33 05 23 – Water Utilities Testing

1.2 REFERENCES, STANDARDS, AND CODES

A. American Association of State Highway and Transportation Officials (AASHTO)
    1. AASHTO M 252 – Corrugated Polyethylene Drainage Pipe
    2. AASHTO M 294 – Corrugated Polyethylene Drainage Pipe (Dual Wall)
B. American Society for Testing and Materials (ASTM)
    1. ASTM C76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
    2. ASTM C494 – Chemical Admixtures for Concrete
    3. ASTM D3034 – Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
    4. ASTM F2306 – Polypropylene (PP) Pipe
    5. ASTM D1785 – PVC Plastic Pipe, Schedules 40, 80, and 120
    6. ASTM D2321 – Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
C. ASTM C443 – Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
D. American Water Works Association (AWWA)
    1. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In.
    2. AWWA C905 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In.
E. National Association of Sewer Service Companies (NASSCO)
    1. PACP – Pipeline Assessment Certification Program
F. Occupational Safety and Health Administration (OSHA)
    1. OSHA 29 CFR Part 1926 – Safety and Health Regulations for Construction
G. International Building Code (IBC)
H. National Fire Protection Association (NFPA) Standards as applicable
I. State and Local Codes and Regulations – Compliance as applicable
J. Manufacturer's published installation and product standards and instructions

1.3 DEFINITIONS

A. Storm Drainage Utilities: Systems and components including pipes, catch basins, manholes, inlets, junction boxes, and associated appurtenances used to collect, convey, and discharge stormwater.
B. Gravity Flow System: Storm drainage system relying on gravity for water conveyance without mechanical pumping.
C. Appurtenances: Components such as inlets, catch basins, manholes, junction boxes, and other fittings associated with storm drainage piping.

1.4 QUALITY ASSURANCE

A. Qualifications:
    1. Installer shall have a minimum of 5 years' experience installing storm drainage utilities of similar scope and complexity.
    2. Manufacturer qualifications shall include a minimum of 10 years producing storm drainage products meeting specified standards.
B. Testing and Inspection:
    1. Perform visual inspections and field testing per ASTM and AASHTO standards to verify compliance.
    2. Contracting entity shall retain an independent third-party testing agency for verifying materials and installation quality.
C. Mock-Up:
    1. When requested by the Engineer, provide a representative mock-up of pipe installation and jointing methods for approval prior to full-scale installation.
D. Compliance:
    1. All materials and installation methods shall comply with referenced standards, codes, and manufacturer instructions.
    2. Installation shall comply with OSHA safety standards including trench safety and confined space entry.

1.5 SUBMITTALS

A. Action Submittals:
    1. Product Data: Submit manufacturer's technical data, specifications, installation instructions, and certifications for all storm drainage products and materials.
    2. Shop Drawings: Submit detailed drawings indicating pipe layout, sizes, slopes, invert elevations, appurtenance locations, joint types, and materials.
    3. Quality Control Submittals: Submit proposed testing procedures and certifications for materials and installation.
    4. Samples: Provide samples of pipe materials, joint gaskets, and other critical components upon request.

5. Warranties: Submit manufacturer's warranties and installer's warranties as specified. Informational Submittals:
6. Inspection Reports: Submit field inspection reports and test results for materials and installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
    1. Deliver materials in manufacturer's original packaging, labeled with product identification and batch numbers.
    2. Schedule delivery to minimize storage time on site and prevent damage.
B. Storage:
    1. Store pipes and appurtenances on level surfaces, elevated above ground to prevent contamination and damage.
    2. Protect stored materials from sunlight, moisture, dirt, and impact damage in accordance with manufacturer's recommendations.
C. Handling:
    1. Handle materials carefully to avoid damage to pipe ends, joints, and coatings.
    2. Use lifting devices designed to support pipe weight evenly and prevent deformation.
    3. Do not drop or roll pipe down slopes or against hard surfaces.

1.7 WARRANTY

A. Manufacturer's Warranty:
    1. Provide manufacturer's standard warranty against defects in materials and workmanship for a minimum period of 10 years from date of substantial completion.
B. Installer's Warranty:
    1. Installer shall warrant all workmanship and installation for a minimum period of 2 years from date of acceptance by Owner.
    2. Warranty shall include repair or replacement of defective components and restoration of disturbed areas.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Advanced Drainage Systems, Inc.
B. Charlotte Pipe and Foundry Company
C. JM Eagle
D. Forterra, Inc.
E. Hanson Pipe & Products

F. McWane, Inc.
G. Smith-Blair, Inc.
H. Hancor, Inc.
I. National Pipe & Plastics, Inc.
J. CertainTeed Corporation

2.2 PIPE MATERIALS

A. High-Density Polyethylene (HDPE) Pipe:
    1. Corrugated HDPE pipe conforming to AASHTO M 252 or M 294.
    2. Pipe diameters and wall thickness as indicated on drawings.
    3. Joints: Integral bell and spigot with gasket per ASTM D3212.
B. Polyvinyl Chloride (PVC) Pipe:
    1. PVC pipe for storm drainage per ASTM D3034 or ASTM F679.
    2. Joints: Elastomeric gasketed joints conforming to ASTM D3212 and ASTM F477.
C. Reinforced Concrete Pipe (RCP):
    1. Reinforced concrete pipe conforming to ASTM C76.
    2. Joints: Rubber gasket joints per ASTM C443.
D. Polypropylene (PP) Pipe:
    1. Polypropylene pipe complying with ASTM F2306 for storm drainage applications.
    2. Joints: Heat-fused or gasketed joints as recommended by manufacturer.
E. Ductile Iron Pipe:
    1. Ductile iron pipe meeting AWWA C151, with protective coatings per AWWA C104.
    2. Joints: Mechanical or push-on per AWWA C111.

2.3 APPURTENANCES

A. Manholes:
    1. Precast concrete manholes conforming to ASTM C478.
    2. Round or rectangular as indicated.
    3. Include watertight gaskets and watertight covers where specified.
B. Catch Basins and Inlets:
    1. Precast concrete or polymer concrete units complying with ASTM C913 or equivalent.
    2. Frames and grates cast iron, meeting ASTM A48 Class 30B.
C. Junction Boxes:
    1. Precast concrete or polymer concrete units as indicated.
    2. Include watertight covers if specified.
D. Pipe Fittings:

1. Provide fittings compatible with pipe materials and meeting applicable ASTM or AWWA standards.

E. Joint Materials:
    1. Gaskets shall be elastomeric, resistant to chemical and environmental degradation.
    2. Joint sealants as recommended by manufacturer.

2.4 BEDDING AND BACKFILL MATERIALS

A. Provide bedding material conforming to Section 31 23 00 and local standards.
B. Material shall be clean, free-draining granular material with particle sizes and gradation per project requirements.
C. Backfill shall be free of debris, organic matter, and comply with compaction requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify trench excavations, bedding conditions, and subgrade are ready to receive storm drainage utilities.
B. Notify Engineer of any unsuitable conditions before installation.
C. Verify dimensions, elevations, and locations of utilities with layout drawings.

3.2 PREPARATION

A. Install geotextile fabric as required under bedding and backfill.
B. Provide dewatering and maintain dry trench conditions during installation.
C. Verify pipe materials and accessories match approved submittals.

3.3 PIPE INSTALLATION

A. Install pipe in accordance with manufacturer's instructions, ASTM D2321, and AASHTO standards.
B. Maintain pipe alignment, grade, and invert elevations as indicated.
C. Assemble joints using specified gaskets and lubricants.
D. Do not exceed allowable bending radii for flexible pipes.
E. Provide necessary supports or cradles for rigid pipes where required.
F. Avoid damage to pipe during placement; replace damaged sections immediately.
G. Temporarily plug pipe ends when work is not in progress to prevent debris entry.

3.4 INSTALLATION OF APPURTENANCES

A. Set precast manholes, catch basins, inlets, and junction boxes on prepared bedding.
B. Align and level appurtenances to design elevations.
C. Seal joints between precast units with watertight gaskets or approved sealants.
D. Install frames, covers, and grates securely and flush with adjacent surfaces.
E. Provide watertight seals for manhole covers where specified.

3.5 BEDDING AND BACKFILL

A. Place bedding material in uniform layers not exceeding 6 inches compacted thickness.
B. Compact bedding to 95 percent of maximum dry density per ASTM D698 or as specified.
C. Backfill pipe zone with select material and compact to specified density.
D. Place final backfill in layers and compact as specified in Section 31 23 00.

3.6 FIELD QUALITY CONTROL

A. Inspect all joints for proper assembly and tightness before backfilling.
B. Conduct leakage and infiltration tests as specified:
    1. Low-pressure air test for concrete pipe or as specified in project documents.
    2. Mandrel or deflection test for flexible pipe.
C. Repair or replace defective pipe sections or joints as directed.
D. Provide test reports and certifications to Engineer.

3.7 CLEANING

A. Remove debris, dirt, and construction materials from inside pipe and appurtenances.
B. Flush system with water to clear sediment before final acceptance.
C. Ensure system is free flowing and unobstructed.

3.8 PROTECTION

A. Protect installed storm drainage utilities from damage during remaining construction.
B. Repair damage immediately at no additional cost to Owner.

3.9 MAINTENANCE

A. Maintain storm drainage utilities until final acceptance.
B. Provide emergency repairs if damage or failure occurs during maintenance period.

END OF SECTION

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 but are not limited to:
    1. Section 31 23 00 – Excavation and Fill
    2. Section 31 23 33 – Trenching
    3. Section 33 05 13 – Underground Utility Inspection and Testing
    4. Section 33 05 16 – Utility Backfilling
    5. Section 33 46 00 – Storm Drainage Structures
    6. Section 33 11 00 – Water Utilities
    7. Section 32 13 13 – Concrete Paving
    8. Section 31 05 19 – Geotextiles for Drainage and Filtration

1.2 SUMMARY

A. This Section includes furnishing and installing storm utility drainage piping systems including pipe, fittings, accessories, and related appurtenances for stormwater conveyance.
B. Types of piping included:
    1. Reinforced concrete pipe (RCP)
    2. High-density polyethylene (HDPE) pipe
    3. Polyvinyl chloride (PVC) pipe
    4. Ductile iron pipe (DIP)
    5. Corrugated metal pipe (CMP)
C. Work includes:
D. Excavation, bedding, and backfill for piping
E. Pipe installation and jointing
F. Testing and inspection
G. Connections to structures and appurtenances

1.3 DEFINITIONS

A. Storm Utility Drainage Piping: Piping designed to collect and convey stormwater away from surfaces and structures to a discharge point or stormwater management system.

1.4 REFERENCES AND STANDARDS

A. The following codes, standards, and publications form a part of this specification to the extent referenced.

1. American Society for Testing and Materials (ASTM)
    a) ASTM A536 – Standard Specification for Ductile Iron Castings
    b) ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
    c) ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
    d) ASTM D3034 – Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
    e) ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
    f) ASTM D1248 – Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
    g) ASTM F2306 – Standard Specification for Corrugated Polyethylene Drainage Pipe
    h) ASTM A746 – Standard Specification for Ductile Iron Gravity Sewer Pipe
2. American Association of State Highway and Transportation Officials (AASHTO)
    a) AASHTO M 252 – Corrugated Polyethylene Drainage Pipe
    b) AASHTO M 36 – Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
3. American Water Works Association (AWWA)
    a) AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast, for Water
    b) AWWA C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances
4. National Association of Sewer Service Companies (NASSCO)
    a) Pipeline Assessment Certification Program (PACP) – For inspection and condition assessment
5. International Plumbing Code (IPC)
6. International Building Code (IBC)
7. Occupational Safety and Health Administration (OSHA) Standards
8. Local jurisdictional requirements and standards.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
    1. Use manufacturers regularly engaged in manufacturing storm drainage piping products of types, materials, and sizes required, with minimum 5 years documented experience.
B. Installer Qualifications:
    1. Employ experienced installers with minimum 3 years experience installing storm utility drainage piping.
    2. Installer shall be familiar with manufacturer's installation instructions and comply fully.
C. Codes and Standards Compliance:

1. Comply with applicable codes, standards, and regulations referenced in this Section and as required by authorities having jurisdiction.

D. Testing and Inspection:
    1. Perform testing and inspection as specified in Part 3 and as required by regulatory agencies.
    2. Testing shall be conducted by qualified independent testing agency.

1.6 SUBMITTALS

A. Action Submittals:
    1. Product Data: Provide manufacturer's catalog sheets, specifications, and installation instructions for each type of pipe, fittings, and accessories.
    2. Shop Drawings: Include layout drawings showing pipe routing, sizes, slopes, joint details, and connections to structures.
    3. Samples: Submit samples of pipe materials, jointing materials, and accessories for approval.
    4. Qualification Statements: Installer and manufacturer qualifications.
B. Informational Submittals:
    1. Certificates: Material test reports and certifications verifying compliance with specified standards.
    2. Test Reports: Results of pipe pressure, leakage, and deflection tests.
    3. Inspection Reports: Inspection records by independent agencies.
    4. Warranty documentation.
    5. Manufacturer's installation instructions.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened packaging with identification labels intact.
B. Store pipes and fittings on clean, level surfaces, protected from dirt, moisture, direct sunlight, and physical damage.
C. Handle pipe with equipment or methods that prevent damage including gouges, cracks, or deformation.
D. Protect pipe ends with end caps or plugs to prevent entry of dirt or debris during storage and installation.
E. Store jointing materials as recommended by manufacturer, protecting from moisture and contamination.

1.8 WARRANTY

A. Provide manufacturer's standard warranty covering defects in materials and workmanship for a minimum period of 10 years from date of substantial completion.

B. Installer shall warrant installation workmanship for a period of 2 years from date of acceptance.
C. Warranty shall include repair or replacement of defective piping, joints, or related components at no cost to the Owner.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Reinforced Concrete Pipe:
    1. Oldcastle Infrastructure
    2. Hanson Pipe & Precast
    3. CRH Americas Materials
B. High-Density Polyethylene (HDPE) Pipe:
    1. AGRU America
    2. Advanced Drainage Systems (ADS)
    3. Chevron Phillips Chemical Company LP
C. Polyvinyl Chloride (PVC) Pipe:
    1. JM Eagle
    2. Charlotte Pipe and Foundry Company
    3. WL Plastics
D. Ductile Iron Pipe:
    1. U.S. Pipe
    2. McWane Ductile
    3. American Cast Iron Pipe Company (ACIPCO)
E. Corrugated Metal Pipe (CMP):
    1. Contech Engineered Solutions
    2. Armtec
    3. National Corrugated Steel Pipe Company

2.2 MATERIALS

A. Reinforced Concrete Pipe (RCP):
    1. Comply with ASTM C76, Class III or heavier as indicated.
    2. Pipe shall be reinforced with steel conforming to ASTM A615 Grade 60.
B. High-Density Polyethylene (HDPE) Pipe:
    1. Comply with ASTM F2306 and AASHTO M 252.
    2. Pipe shall be smooth interior, corrugated exterior profile unless otherwise indicated.
    3. Minimum cell classification shall comply with ASTM D3350 PE4710.
C. Polyvinyl Chloride (PVC) Pipe:
    1. Comply with ASTM D3034 for SDR 35 or as indicated.

2. Pipe and fittings shall be manufactured from virgin PVC resin meeting ASTM D1784.

D. Ductile Iron Pipe (DIP):
   1. Comply with AWWA C151 and ASTM A746.
   2. Pipe shall be cement lined and seal coated per AWWA C104.

E. Corrugated Metal Pipe (CMP):
   1. Comply with AASHTO M 36.
   2. Pipe shall be metallic coated (galvanized or aluminized) per ASTM A123 or ASTM A849.

F. Joints and Fittings:
   1. Provide jointing systems recommended by pipe manufacturer including gasketed bell-and-spigot, restrained joints, or welded joints as applicable.
   2. Provide fittings and adapters compatible with pipe materials and system design pressures.

2.3 ACCESSORIES

A. Couplings, Adapters, and Transition Fittings:
   1. Provide corrosion-resistant couplings compatible with pipe materials and sizes.

B. Pipe Bedding and Surround Materials:
   1. Provide granular bedding material conforming to Section 31 23 00 and local requirements.

C. Tracer Wire and Warning Tape:
   1. Provide continuous tracer wire for all non-metallic piping per local utility requirements.
   2. Provide detectable warning tape above piping as specified in Section 31 05 13.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that trenching, bedding, and structural conditions are ready to receive piping.
B. Inspect pipe materials for damage before installation; do not install damaged pipe.
C. Verify invert elevations, slopes, and alignment per drawings.

3.2 PREPARATION

A. Excavate trenches to lines and grades indicated. Maintain trench bottom free of loose or soft material.
B. Place bedding material as specified and compact to required density.

3.3 INSTALLATION

A. Install pipe and fittings in accordance with manufacturer's instructions, ASTM D2321, and AWWA C600 where applicable.
B. Maintain minimum cover depth as required by code or project documents.
C. Lay pipe true to alignment and grade, with uniform slope to ensure positive drainage.
D. Join pipe using recommended jointing method ensuring watertight connections.
E. Install tracer wire continuously with non-metallic pipe and provide access points at intervals.
F. Provide adequate support and embedment to prevent displacement or damage.
G. Install detectable warning tape minimum 12 inches above pipe crown.
H. Provide protection from floating or shifting during backfilling.

3.4 BACKFILLING

A. Backfill trenches in layers not exceeding 8 inches, compacting each layer to specified density.
B. Protect pipe from damage during backfilling operations.

3.5 FIELD QUALITY CONTROL

A. Inspection and Testing:
    1. Perform deflection testing on flexible piping (HDPE, PVC) after backfilling to verify compliance with ASTM D2321.
    2. Perform leakage tests on piping systems as specified in Section 33 05 13.
    3. Submit test reports and certification of compliance.
B. Repair or replace defective piping or joints as directed.

3.6 CLEANING

A. Remove debris and foreign material from piping system prior to final acceptance.
B. Flush piping with clean water to remove sediment if required.

3.7 PROTECTION

A. Protect installed piping from damage until final acceptance.
B. Repair damage to pipe, joints, or coatings at no cost to Owner.

END OF SECTION 33 41 00

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Section 31 23 00 – Excavation and Fill
B. Section 33 05 00 – Common Work Results for Utilities
C. Section 33 46 00 – Subdrainage Systems
D. Section 33 70 00 – Stormwater Conveyance
E. Section 01 33 00 – Submittal Procedures
F. Section 01 78 00 – Closeout Submittals

REFERENCES, STANDARDS, AND CODES

A. American Society for Testing and Materials (ASTM)
    1. ASTM A48 – Standard Specification for Gray Iron Castings
    2. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
    3. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections
    4. ASTM C506 – Standard Specification for Reinforced Concrete Circular Storm Drainage Pipe
    5. ASTM C923 – Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals
    6. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
    7. ASTM F2306 – Standard Specification for Structural-Grade Polyethylene (PE) Plastic Pipe
B. American Association of State Highway and Transportation Officials (AASHTO)
    1. AASHTO M 170 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
    2. AASHTO M 198 – Standard Specification for Reinforced Concrete Arch Pipe, Storm Drain, and Sewer Pipe
C. National Association of Sewer Service Companies (NASSCO)
    1. NASSCO PACP – Pipeline Assessment Certification Program Standards
D. National Fire Protection Association (NFPA)
    1. NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities (as applicable)
E. Occupational Safety and Health Administration (OSHA)
    1. OSHA 29 CFR Part 1926 – Safety and Health Regulations for Construction
F. Local, State, and Federal Codes
    1. Local municipal storm drainage and sewer codes
    2. State Department of Transportation (DOT) standards
    3. Environmental Protection Agency (EPA) regulations on stormwater management

4. Other Industry Standards
5. American Concrete Institute (ACI) 318 – Building Code Requirements for Structural Concrete
6. American Concrete Institute (ACI) 350 – Environmental Engineering Concrete Structures
7. Precast/Prestressed Concrete Institute (PCI) Design Handbook

1.3 SUMMARY

A. This section includes requirements for the materials, fabrication, installation, and testing of storm drainage structures including manholes, catch basins, inlets, junction boxes, and related accessories.
B. Types of structures include precast reinforced concrete, cast-in-place concrete, polymer concrete, and plastic drainage structures.
C. Provide all labor, materials, equipment, and services necessary for complete and proper installation in accordance with the Contract Documents.

1.4 SUBMITTALS

A. Action Submittals
    1. Product Data: Provide manufacturer's technical data, installation instructions, and certification of compliance with specified standards.
    2. Shop Drawings: Include layout, dimensions, reinforcement details, jointing methods, and accessories.
    3. Samples: Submit representative samples of precast concrete, polymer concrete, or plastic components as applicable.
    4. Quality Assurance Documentation: Include test reports, certifications, and inspection records.
B. Informational Submittals
    1. Installation Procedures: Detailed step-by-step methods and sequencing.
    2. Manufacturer's Warranty: Provide warranty documentation as specified in this section.
    3. Inspection and Testing Reports: Submit results of inspections and tests conducted during fabrication and installation.
    4. Maintenance Data: Include cleaning, inspection, and repair recommendations.

1.5 QUALITY ASSURANCE

A. Fabricators and manufacturers of precast concrete and polymer concrete structures shall have a minimum of five years' documented experience in producing storm drainage structures of similar size and complexity.
B. Testing laboratories performing quality control testing shall be accredited by an accepted authority such as AASHTO Accreditation Program or equivalent.

C. Comply with requirements of ASTM C478 and ACI 318 for precast reinforced concrete manholes and structures.
D. Perform dimensional and visual inspections of precast units prior to shipment.
E. Installer qualifications: Installers shall have at least three years of documented experience with storm drainage structure installation and shall comply with OSHA safety regulations.
F. Conduct pre-installation conference to review procedures, safety, and quality assurance requirements.
G. Inspection and testing during installation shall include verification of alignment, grade, joint integrity, and surface finish.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original packaging and containers, labeled with manufacturer's name, product description, and batch number.
B. Store precast concrete units on firm, level ground with blocking to prevent damage and deformation.
C. Protect polymer concrete and plastic components from direct sunlight and extreme temperatures during storage.
D. Handle all materials with care to prevent chipping, cracking, or other damage. Use appropriate lifting devices and follow manufacturer's recommendations.
E. Store gaskets, sealants, and adhesives in clean, dry locations protected from freezing and contamination.
F. Protect installed structures from construction traffic and debris until final acceptance.

1.8 WARRANTY

A. Provide manufacturer's standard warranty covering materials and workmanship for a minimum period of five (5) years from date of final acceptance.
B. Installer shall warrant workmanship and installation for a minimum period of two (2) years from date of final acceptance.
C. Warranty shall include repair or replacement of defective materials or workmanship at no cost to the Owner.
D. Provide warranties in written form, executed by authorized representatives of manufacturer and installer.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Precast Concrete Structures:
    1. Oldcastle Infrastructure
    2. Hanson Pipe & Precast

3. CEMEX
4. Campbell Concrete

B. Polymer Concrete Structures:
   1. Enduro Composites
   2. Endicott Polymer Products

C. Plastic Drainage Structures (HDPE, PVC):
   1. Advanced Drainage Systems, Inc. (ADS)
   2. JM Eagle
   3. Charlotte Pipe and Foundry

D. Accessories and Gaskets:
   1. Press-Seal Gasket Corporation
   2. Denso North America
   3. Romac Industries

2.2 MATERIALS

A. Precast Reinforced Concrete
   1. Concrete: Minimum compressive strength 4000 psi at 28 days, air-entrained, with admixtures as required for durability.
   2. Reinforcement: ASTM A615 Grade 60 deformed steel bars or welded wire fabric conforming to ACI 318.
   3. Joints: Rubber gaskets conforming to ASTM C443 or resilient connectors conforming to ASTM C923.

B. Polymer Concrete
   1. Resin matrix: Polyester or epoxy resin system resistant to chemicals commonly found in stormwater.
   2. Aggregate: Silica sand, quartz, or other inert materials meeting manufacturer specifications.

C. Plastic Structures
   1. Pipe and fittings: HDPE or PVC conforming to ASTM D3034 or ASTM F2306.
   2. Joints: Flexible gasketed joints with water-tight seals.

D. Cast-in-Place Concrete
   1. Concrete: Minimum 4000 psi compressive strength at 28 days.
   2. Reinforcement: ASTM A615 Grade 60 or as specified.

E. Frames and Covers
   1. Material: Cast iron conforming to ASTM A48 Class 30B or ductile iron conforming to ASTM A536.
   2. Design: Load ratings as specified by AASHTO HS-20 or as required by project.
   3. Finish: Manufacturer’s standard protective coating to resist corrosion.

F. Sealants and Joint Materials
   1. Sealants: Polyurethane or polysulfide sealants compatible with adjacent materials and resistant to stormwater constituents.

2. Gaskets: Neoprene, rubber, or other elastomeric materials meeting ASTM standards.

2.3 FABRICATION

A. Precast units shall be fabricated in accordance with ASTM C478 and PCI guidelines.
B. Provide lifting inserts and points as required to facilitate safe handling and installation.
C. Ensure all joints are properly formed and gaskets installed per manufacturer instructions.
D. Frames and covers shall be manufactured to precise dimensions to ensure proper fit and function.
E. Polymer concrete units shall be cured and finished to provide smooth, impervious surfaces.
F. Plastic structures shall be fabricated in continuous lengths or sections as specified, with jointing systems tested for watertightness.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that excavations are complete and dimensions, elevations, and bedding materials conform to project requirements.
B. Inspect delivered materials for damage, defects, and compliance with Contract Documents.
C. Notify the Architect/Engineer of any discrepancies or conditions detrimental to installation.

3.2 PREPARATION

A. Prepare bedding surfaces to provide uniform support and prevent differential settlement.
B. Install bedding material in accordance with Section 31 23 00 and compact to specified density.
C. Ensure adjacent pipes and utilities are installed and tested prior to structure installation.

3.3 INSTALLATION

A. Install storm drainage structures in accordance with manufacturer's instructions, ASTM standards, and Contract Documents.
B. Maintain alignment, grade, and elevation within tolerances specified.
C. Set precast units plumb and true; use shims and blocking as necessary.
D. Install joint gaskets and sealants to provide watertight connections; verify integrity by visual inspection and testing if required.
E. Place cast-in-place concrete structures with proper formwork, reinforcement, and curing practices.

F. Install frames and covers securely; adjust to finished grade and ensure smooth operation.
G. Backfill around structures in layers not exceeding 8 inches loose depth; compact to specified density without damaging structures.
H. Protect installed structures from damage during subsequent construction activities.

3.4 FIELD QUALITY CONTROL

A. Inspect installed structures for alignment, grade, plumbness, and joint integrity.
B. Conduct leakage tests on manholes and inlets as specified or as directed by Engineer.
C. Verify frame and cover load ratings and installation.
D. Document inspection results and test reports; submit to Architect/Engineer for review.
E. Correct deficiencies promptly and retest as required.

3.5 CLEANING

A. Remove construction debris and excess materials from inside and around storm drainage structures.
B. Flush pipe and structures to remove sediment and foreign matter prior to final acceptance.
C. Provide maintenance instructions to Owner for periodic inspection and cleaning.

3.6 PROTECTION

A. Protect completed storm drainage structures from damage by construction activities and weather until final acceptance.
B. Repair or replace damaged components at no additional cost to Owner.

END OF SECTION 33 49 00