ADDENDUM - #01
Date:       August 1, 2017
Project:    Brook Hill School 2017 Boarding Houses
Project No: 17008

To: All Bidders of Record

Acknowledge receipt of the Addendum by inserting its number on your construction proposal. This Addendum shall form a part of the Contract Documents and modifies them as follows:

Item 01  Tax Exempt Form; The attached Tax Exempt Form shall be used for this project.
Item 02  Specifications Section 00300 Form of Proposal; Delete subparagraph 1.02 Bid Security.
Item 03  Specifications Section 00300 Form of Proposal; Subparagraph 1.04 has been omitted.
Item 04  Specifications Section 00100 Instructions to Bidders; Subparagraph 1.08, the superintendent should be named in Section 00300 Form of Proposal, subparagraph 1.02.
Item 05  Specifications Section 00100 Instructions to Bidders; Subparagraph 1.09, delete this paragraph.
Item 06  Drawings; The drawings show one House. The intent is to build two houses from the same set of drawings.
Item 07  MEP Specifications; Included with this addendum are the specifications for MEP.
Item 08  MEP Drawings; Included with this addendum are MEP drawings with an engineer’s seal.
Item 09  Civil Drawings; Included with this addendum are Civil drawings with an engineer’s seal.
Item 10  Specifications Section 10522 Fire Extinguisher Cabinets and Section 10523 Fire Extinguishers; Include five units to be installed throughout the house. The units shall be semi-recessed, brushed metal finish.
Item 11  Specifications Section 00300 Form of Proposal; Add a contingency to the Base Bid in the amount of $150,000.
Item 12  The bids will not include landscaping. Bidders are responsible for grading around site when finished and managing erosion during the construction period.
Item 13  A pre-bid conference is not scheduled. All contractors are permitted to visit the site. Contact Mike Butler at 903-592-2244 to schedule a time to meet at the site.
Item 14  Specifications Section 00020 Invitation to Bid; The bid date shall be changed. The new date shall be Thursday, August 17, 2017. Same time and submittal requirements.
Item 15  Structural Drawings; Included with this addendum are revised details.
Item 16  Architectural Drawings; Included with this addendum are revised details.
Item 17  Specifications Division 7; Division 7 is included with this addendum.

END OF ADDENDUM
TEXAS SALES AND USE TAX EXEMPTION CERTIFICATION

Name of purchaser: firm or agency:
The Brook Hill School, Tex.

Address:
1051 N. Houston

City, state, zip code:
Bullard, TX 75757

Phone (Area code and number):
903-844-5000

I, the purchaser named above, claim an exemption from payment of sales and use taxes (for the purchase of taxable items described below or on the attached order or invoice) from:

Seller:

Street address: ___________________________________________ City, State, ZIP code:

Description of items to be purchased or on the attached order or invoice:

Purchaser claims this exemption for the following reason:
Nonprofit Private Christian School

I understand that I will be liable for payment of all state and local sales or use taxes which may become due for failure to comply with the provisions of the Tax Code and/or all applicable law.

I understand that it is a criminal offense to give an exemption certificate to the seller for taxable items that I know, at the time of purchase, will be used in a manner other than that expressed in this certificate, and depending on the amount of tax evaded, the offense may range from a Class C misdemeanor to a felony of the second degree.

Purchaser: ___________________________   Headmaster: ___________________________   Date: 1/4/2017

NOTE: This certificate cannot be issued for the purchase, lease, or rental of a motor vehicle.

THIS CERTIFICATE DOES NOT REQUIRE A NUMBER TO BE VALID.

Sales and Use Tax "Exemption Numbers" or "Tax Exempt" Numbers do not exist.

This certificate should be furnished to the supplier. Do not send the completed certificate to the Comptroller of Public Accounts.
SECTION 00020-INVITATION TO BID

1.01 Bids Due:
A. Date: August 17, 2017
   Time: 2:00 pm
   Place: Butler Architectural Group
       400 S. Broadway Ave., Ste 001
       Tyler, TX 75702
   Or, electronically by email at:
       mike@butlerarchgroup.com

1.02 Drawings and Specifications
A. Drawings and Specifications shall be delivered electronically to bidders.
B. The Drawings and Specifications shall remain the property of the Architect.

1.03 Bid Security
A. Not required.

1.04 Bid Received:
A. Bids will be received on a single lump sum basis. The Owner reserves the right to award
   the contract to any Bidder, thus reserving the right to reject any or all bids and waive any
   technicalities or formalities in connection with the receipt of proposals and awarding of
   the Contract.

B. The General Contractor and his subcontractors are encouraged to submit for review
   alternates to specified products. The submissions will be reviewed and vetted for
   conformity to the intent of the project.

END OF SECTION
SECTION 00100-INSTRUCTIONS TO BIDDERS

1.01 All work shall be governed by the American Institute of Architects Standard Document No. A701, Instructions to Bidders, 1997 Edition, which is made a part of the bidding requirements and is included in these specifications.

1.02 The following supplements modify, change, delete from or add to the "Instructions to Bidders", Document A701. Where any article of the Instructions to Bidders is modified or any paragraph, subparagraph or clause thereof is modified or deleted by these Supplementary Instructions, the unaltered provisions of that article, paragraph, subparagraph or clause shall remain in effect.

1.03 Add the following subparagraph 2.1.5

2.1.5 He is cognizant that no bill for extra work will be allowed due to unforeseen difficulties encountered about which he might have informed himself by careful examination of the existing conditions of the site.

1.04 Add the following subparagraph 2.1.6

2.1.6 He has carefully examined the drawings and Specifications of not only his part of the project but also that covering all other parts. If any clarifications may have been needed regarding the division of the various parts of the work, he has notified the Architect in ample time to issue clarifying addenda.

1.05 Add the following sub paragraph 4.1.8

4.1.8 Bids will be received on a lump sum basis for the base bid.

1.06 Add the following sentence to subparagraph 4.4.1

The stipulated time shall be 30 calendar days after receipt of bids.

1.07 Add the following sub paragraph 5.3.3

5.3.3 The best bid will be determined by consideration of time as well as bid amount.

1.08 The Contractor shall designate a Job Superintendent to take overall responsibility for the project. This man shall remain on the job during the period of construction. The job superintendent will be named on the bid form. (Refer to Section 00700 subparagraph 3.9.1).

1.09 A cashier's check, certified check, or acceptable bidder's bond payable to the Owner in an amount not less than 5% of the largest possible total for the bid submitted, including the consideration of possible add alternates must accompany each bid. This bond guarantees the Contractor will sign a contract within fifteen (15) days after being notified of selection for the award of the Contract. If the undersigned bidder defaults the bid security will become the property of the Owner.

1.10 Performance Bond, Payment Bond & Insurance

A. The Owner shall require the Contractor to furnish a bond covering the faithful performance of the entire construction contract and the payment of all obligations arising thereunder. Premiums for this bond will be included in the Contractor's proposal.

B. Each and every Contractor and Subcontractor shall maintain all required insurance, including full worker's compensation coverage during the life of the Contract and until the Owner has assumed the necessary insurance coverage.

C. Contractor shall submit one copy of coverage policies.

END OF SECTION
SECTION 00300-FORM OF PROPOSAL

FORM OF BID

Having examined the Bidding and Contract Documents prepared by Butler Architectural Group, Tyler, Texas for the project entitled:

**Brook Hill School Boarding Houses**

and having inspected the site and being familiar with such local conditions as may affect the work, I (we) propose to furnish all labor and materials necessary for and reasonably incidental to the proper execution and completion of all work as described in the Contract Documents, including but not limited to General Construction for:

1.01 BASE BID SUM:
Base Bid Sum of:

_________________________________________________________ Dollars,

($__________________).  (Amounts shall be shown in both words and figures.)

1.02 BID SECURITY:
Enclosed is a bid bond, certified check or cashier's check in the amount of:

______________________________________________________ Dollars,

($_________________) and is in the sum equal to five percent (5%) of the base bid plus all ADD alternates.

1.03 JOB SUPERINTENDENT:
The job superintendent for this project will be______________________________.

1.05 RECEIPT OF ADDENDA:
The undersigned hereby acknowledges receipt of the following addenda to the Drawings and Specifications, all of the provisions and requirements of which addenda shall be a part of the Contract Documents.

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1.06 CHANGE ORDER FEE:
For all Change Order work authorized by the Owner a __________ percent (_____%)
fee will be charged for Overhead, Insurance and Profit over the total Net Cost of all material and labor.

1.07 TIME FOR COMPLETION:
The Undersigned agrees to complete the work in all and every part in
_________________________________________________________ (_______) calendar days fro the date of the
executed Contract or from the date of the "Notice of Proceed" issued by the Owner.

1.08 ALTERNATES:
The undersigned proposes to modify this Base Bid in the sums indicated for the following Alternate Construction.

Alternate #1: Provide a Performance Bond for the Project

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RESPECTFULLY SUBMITTED,

CORPORATIONS FILL IN THE FOLLOWING:  BIDDERS OTHER THAN CORPORATIONS FILL IN THE FOLLOWING:

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Cavity-wall insulation.
   2. Concealed building insulation.
   3. Sound attenuation insulation.
   4. Loose fill insulation.

B. Related Sections include the following:
   1. Division 7 Section “SBS-Modified Bituminous Membrane Roofing” for insulation specified as part of roofing construction.
   2. Division 7 Section “Fire-Resistive Joint Systems” for insulation installed as part of a perimeter fire-resistive joint system.
   3. Division 9 Sections “Gypsum Board Assemblies” and “Gypsum Board Shaft-Wall Assemblies” for installation in metal-framed assemblies of insulation specified by referencing this Section.
   4. Division 15 Sections “Duct Insulation” and “Pipe Insulation.”

1.3 DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 PERFORMANCE REQUIREMENTS

A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.

   1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm (13-m/s) air velocity.
   2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosum on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.
1.5 SUBMITTALS
   A. Product Data: For each type of product indicated.

1.6 QUALITY ASSURANCE
   A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
   B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GLASS-FIBER BLANKET INSULATION
   A. Manufacturers:
      1. CertainTeed Corporation.
      2. Guardian Fiberglass, Inc.
      4. Knauf Fiber Glass.
      5. Owens Corning.
   B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
C. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:

1. 3-5/8 inches (92 mm) thick with a thermal resistance of 11 deg F x h x sq. ft./Btu at 75 deg F (1.9 K x sq. m/W at 24 deg C).
2. 5-1/2 inches (140 mm) thick with a thermal resistance of 19 deg F x h x sq. ft./Btu at 75 deg F (3.3 K x sq. m/W at 24 deg C).
3. 9-1/2 inches (241 mm) thick with a thermal resistance of 30 deg F x h x sq. ft./Btu at 75 deg F (5.2 K x sq. m/W at 24 deg C).

D. Where glass-fibered sound attenuation blankets are indicated, provide blankets in batt or roll form with the following thickness:

1. 3 inches (76 mm) thick.

2.3 LOOSE FILL INSULATION

A. Manufacturers:

1. CertainTeed Corporation.
2. Guardian Fiberglass, Inc.
4. Knauf Fiber Glass.
5. Owens Corning.

B. Loose fill insulation:

1. Thermal Resistance (R-Value) (ASTM C518): R30
3. Critical Radiant Flux (ASTM E970): 0.11 Btu/ft² x s (0.12 W/cm²) or greater.
4. Water Vapor Sorption (ASTM C1104): 5% or less.
8. Thickness: 12 inch
10. Smoke Developed (ASTM E84): 50, maximum.

2.4 AUXILIARY INSULATING MATERIALS

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer’s written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer’s standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer’s written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically.

3.5 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Install 3-inch (76-mm-) thick, unfaced glass-fiber blanket insulation over suspended ceilings at partitions in a width that extends insulation 48 inches (1219 mm) on either side of partition.

3.6 INSTALLATION OF LOOSE FILL INSULATION

A. Place loose-fill insulation into spaces and onto surfaces as shown, by machine blowing to comply with ASTM C1015. Level horizontal applications to uniform thickness as indicated. Hold insulation back from air vents, flues and heat-generating appliances.

3.7 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07210
SECTION 07311 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Asphalt shingles.
2. Underlayment.

B. Related Sections:

1. Division 6 Section “Miscellaneous Carpentry” for wood framing.
2. Division 7 Section “Sheet Metal Flashing and Trim” for metal roof penetration flashings, counterflashings, and flashings.

1.3 DEFINITION

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's “The NRCA Roofing and Waterproofing Manual” for definitions of terms related to roofing work in this Section.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sample: Submit sample of actual material for color verification.

C. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain ridge and hip cap shingles from single source from single manufacturer.

C. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
1. Exterior Fire-Test Exposure: Class A; ASTM E 108 or UL 790, for application and roof slopes indicated.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated, weathertight location according to asphalt shingle manufacturer's written instructions. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.

1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.

B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install asphalt shingles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.

1.8 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Manufacturing defects.
   b. Structural failures including failure of asphalt shingles to self-seal after a reasonable time.

2. Material Warranty Period: 40 years from date of Substantial Completion, prorated, with first 12 years nonprorated.

B. Special Project Warranty: Roofing Installer's Warranty, or warranty form at end of this Section, signed by roofing Installer, covering the Work of this Section, in which roofing Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

1.9 EXTRA MATERIALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Asphalt Shingles: 100 sq. ft (9.3 sq. m) of each type, in unbroken bundles.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES


1. Product: Subject to compliance with requirements, provide products to match existing adjacent roof by one of the following:
   b. CertainTeed Corporation.
   c. Elk Premium Building Products, Inc.; an ElkCorp company.
   d. Emco Building Products Corp.
   e. GAF Materials Corporation.
   f. IKO.
   g. Malarkey Roofing Products.
   h. Owens Corning.
   i. PABCO Roofing Products.
   j. TAMKO Roofing Products, Inc.

2. Algae Resistance: Granules treated to resist algae discoloration.

3. Basis of Design: GAF “Camelot II”

4. Color: Weathered Wood

B. Hip and Ridge Shingles: Manufacturer’s standard units to match asphalt shingles.

2.2 UNDERLAYMENT MATERIALS

A. Underlayment: ASTM D 4869.

1. Manufacturers: Subject to compliance with requirements, provide DuPont RoofLiner with Elvaloy or underlayment recommended by shingle manufacturer as part of roofing system.

B. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 30- to 40-mil-(0.76- to 1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release paper backing; cold applied.

2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.

3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
   a. Carlisle Coatings & Waterproofing, Inc.
   c. Henry Company.
2.3 RIDGE VENTS

A. Flexible Ridge Vent: Manufacturer's standard, compression-resisting, three-dimensional, open-nylon or polyester-mat filter bonded to a nonwoven, nonwicking, geotextile fabric cover.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

   a. GAF Materials Corporation.
   b. Obdyke, Benjamin Incorporated.
   c. TAMKO Roofing Products, Inc.

2.4 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch-(3-mm-) diameter, shank, sharp-pointed, with a minimum 3/8-inch-(9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch(19 mm) into solid wood decking or extend at least 1/8 inch(3 mm) through OSB or plywood sheathing.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch (25-mm) minimum diameter.

2.5 METAL FLASHING AND TRIM

A. General: Comply with requirements in Division 7 Section "Sheet Metal Flashing and Trim."

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and penetrations through asphalt shingles.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer’s written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (50 mm) over underlying course. Lap ends a minimum of 4 inches (100 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm). Fasten with felt underlayment nails.

C. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck at perimeter of roof, valleys, and over ridges. Cut slot in underlayment at ridge vent locations. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated on Drawings, lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

3.3 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Division 7 Section "Sheet Metal Flashing and Trim."

1. Install metal flashings according to recommendations in ARMA’s "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA’s "The NRCA Roofing and Waterproofing Manual."

3.4 ASPHALT SHINGLE INSTALLATION


B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip at least 7 inches (175 mm) wide with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 3/4 inch (19 mm) over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer’s recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Install asphalt shingles by single-strip column or racking method, maintaining uniform exposure. Install full-length first course followed by cut second course, repeating alternating pattern in succeeding courses.

E. Fasten asphalt shingle strips with a minimum of four, five, or six roofing nails located according to manufacturer’s written instructions.
1. Where roof slope exceeds 20:12, seal asphalt shingles with asphalt roofing cement spots after fastening with additional roofing nails.
2. Where roof slope is less than 4:12, seal asphalt shingles with asphalt roofing cement spots.
3. When ambient temperature during installation is below 50 deg F (10 deg C) seal asphalt shingles with asphalt roofing cement spots.

F. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

G. Ridge and Hip Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.

1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION 07311
PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Fiber cement lap siding. Trim, fascia, moulding and accessories as required

1.2. REFERENCES

B. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.3. SUBMITTALS

A. Submit under provisions of Section 01300.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
C. Shop Drawings: Provide detailed drawings of atypical non-standard applications of cementitious siding materials which are outside the scope of the standard details and specifications provided by the manufacturer.
D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

1.4. QUALITY ASSURANCE

A. Installer Qualifications: Minimum of 2 years experience with installation of similar products.
B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.
C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6. PROJECT CONDITIONS
A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s absolute limits.

1.7. WARRANTY

A. Product Warranty: Limited, non-pro-rated product warranty.
   1. Artisan HZ10 lap siding for 30 years.

B. Finish Warranty: Limited product warranty against manufacturing finish defects.

C. Workmanship Warranty: Application limited warranty for 2 years.

PART 2 - PRODUCTS

1.1. MANUFACTURERS

A. Acceptable Manufacturer: James Hardie Building Products, Inc., which is located at: 26300 La Alameda Suite 400; Mission Viejo, CA 92691; Toll Free Tel: 866-274-3464; Tel: 949-367-4980; Email: request info (info@jameshardie.com); Web: www.jameshardiecommercial.com

B. Requests for approval of equal substitutions will be considered in accordance with provisions of Section 01600.

1.2. SIDING

A. Artisan HZ10 lap siding requirement for Materials:
   1. Fiber-cement Siding - complies with ASTM C 1186 Type A Grade II.
   2. Fiber-cement Siding - complies with ASTM E 136 as a noncombustible material.
   3. Fiber-cement Siding - complies with ASTM E 84 Flame Spread Index = 0, Smoke Developed Index = 5.
   5. Manufacturer's Technical Data Sheet.

B. Lap Siding: Artisan HZ10 Lap Siding as manufactured by James Hardie Building Products, Inc.

C. Type: Smooth 7-1/4 inches (184 mm) with 6 inches (152 mm) exposure.

1.3. FINISHES

A. Factory Primer: Provide factory applied universal primer.

B. Topcoat: Refer to Section 09900 and Exterior Finish Schedule.

PART 3 - EXECUTION

1.1. EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Nominal 2 inch by 4 inch (51 m by 102 mm) wood framing selected for minimal shrinkage and complying with local building codes, including the use of water-resistant barriers or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.

D. Install water-resistant barriers and claddings to dry surfaces.

E. Repair any punctures or tears in the water-resistant barrier prior to the installation of the siding.

F. Protect siding from other trades.

1.2. PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Install a water-resistant barrier is required in accordance with local building code requirements.

D. The water-resistant barrier must be appropriately installed with penetration and junction flashing in accordance with local building code requirements.

E. Install Engineered for ClimateTM HardieWrapTM weather barrier in accordance with local building code requirements.

1.3. INSTALLATION

A. Install materials in strict accordance with manufacturer's installation instructions.

B. Starting: Install a minimum 1/4 inch (6 mm) thick lath starter strip at the bottom course of the wall. Apply planks horizontally with minimum 1-1/4 inches (32 mm) wide laps at the top. The bottom edge of the first plank overlaps the starter strip.

C. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.

D. Align vertical joints of the planks over framing members.

E. Maintain clearance between siding and adjacent finished grade.

F. Locate splices at least one stud cavity away from window and door openings.

G. Use off-stud metal joiner in strict accordance with manufacturer's installation instructions.

H. Wind Resistance: Where a specified level of wind resistance is required Hardieplank lap siding is installed to framing members and secured with fasteners described in Table No. 2 in National Evaluation Service Report No. NER-405.

I. Face nail to sheathing.

J. Locate splices at least 12 inches (305 mm) away from window and door openings.

1.4. FINISHING
A. Finish unprimed siding with a minimum one coat high quality, alkali resistant primer and one coat of either, 100 percent acrylic or latex or oil based, exterior grade topcoats or two coats high quality alkali resistant 100 percent acrylic or latex, exterior grade topcoat within 90 days of installation. Follow paint manufacturer’s written product recommendation and written application instructions.

B. Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer’s written product recommendation and written application instructions.

1.5. PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Formed Products:
   a. Formed roof drainage sheet metal fabrications.
   b. Formed low-slope roof sheet metal fabrications.
   c. Formed wall sheet metal fabrications.

B. Related Sections:

1. Division 6 Section “Miscellaneous Carpentry” for wood nailers, curbs, and blocking.
2. Division 7 Section “Adhered TPO roofing systems”
3. Division 7 Section “Metal Roof Panels” for sheet metal flashing and trim integral with metal roof panels.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:


C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches (1:5).

C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Accessories and Miscellaneous Materials: Full-size Sample.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof parapet, including caps and cleats approximately 10 feet (3.0 m) long, including supporting construction cleats, seams, attachments and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90(Z275) coating designation; structural quality.
2. Surface: Smooth, flat
3. Exposed Coil-Coated Finish:
   a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers’ written instructions.
4. Color: As selected by Architect from manufacturer’s full range
5. Concealed Finish: Pre-treat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   
   a. Exposed Fasteners: NO EXPOSED FASTENERS ALLOWED.
   
   b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, non-corrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.


2.3 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA’s "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool
   marks and true to line and levels indicated, with exposed edges folded back to form
   hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not
   allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to
   a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and
   within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to
   tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric
   sealant.

E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion
   joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl
   sealant concealed within joints.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or
   from compatible, non-corrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural
   Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less
   than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with
   elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

I. Do not use graphite pencils to mark metal surfaces.

2.4 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes,
   and other accessories as required. Fabricate in minimum 96-inch-(2400-mm-) long sections.
   Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of
   size recommended by SMACNA but not less than twice the gutter thickness. Fabricate
   expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter
   accessories from same metal as gutters.

1. Gutter Style: SMACNA designation [A] [B] [C] [D] [E] [F] [G] [H] [I] [J] [K] [L].
2. Expansion Joints: [Lap type] [Butt type] [Butt type with cover plate] [Built in].
3. Accessories: [Continuous removable leaf screen with sheet metal frame and
   hardware cloth screen] [Wire ball downspout strainer] [Valley baffles].
4. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:
   a. Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight (thickness)>.
   b. Aluminum: [0.032 inch (0.81 mm)] <Insert thickness> thick.
   c. Stainless Steel: [0.016 inch (0.40 mm)] <Insert thickness> thick.
   d. Zinc-Tin Alloy-Coated Stainless Steel: [0.015 inch (0.38 mm)] <Insert thickness>
      thick.
e. Zinc-Tin Alloy-Coated Copper:  [16 oz./sq. ft.(0.55 mm thick)] <Insert weight(thickness)>.
f. Galvanized Steel:  [0.022 inch(0.56 mm)] <Insert thickness> thick.
g. Aluminum-Zinc Alloy-Coated Steel:  [0.022 inch(0.56 mm)] <Insert thickness> thick.
h. Zinc:  [0.032 inch(0.80 mm)] [0.039 inch(1.00 mm)] <Insert thickness> thick.

5. Gutters with Girth 16 to 20 Inches(410 to 510 mm):  Fabricate from the following materials:

a. Copper:  [16 oz./sq. ft.(0.55 mm thick)] <Insert weight(thickness)>.
b. Aluminum:  [0.040 inch(1.02 mm)] <Insert thickness> thick.
c. Stainless Steel:  [0.019 inch(0.48 mm)] <Insert thickness> thick.
d. Zinc-Tin Alloy-Coated Stainless Steel:  [0.018 inch(0.46 mm)] <Insert thickness> thick.
e. Zinc-Tin Alloy-Coated Copper:  [16 oz./sq. ft.(0.55 mm thick)] <Insert weight(thickness)>.
f. Galvanized Steel:  [0.028 inch(0.71 mm)] <Insert thickness> thick.
g. Aluminum-Zinc Alloy-Coated Steel:  [0.028 inch(0.71 mm)] <Insert thickness> thick.
h. Zinc:  [0.039 inch(1.00 mm)] [0.048 inch(1.25 mm)] <Insert thickness> thick.

6. Gutters with Girth 21 to 25 Inches(530 to 640 mm):  Fabricate from the following materials:

a. Copper:  [20 oz./sq. ft.(0.68 mm thick)] <Insert weight(thickness)>.
b. Aluminum:  [0.050 inch(1.27 mm)] <Insert thickness> thick.
c. Stainless Steel:  [0.025 inch(0.64 mm)] <Insert thickness> thick.
d. Zinc-Tin Alloy-Coated Stainless Steel:  [0.024 inch(0.61 mm)] <Insert thickness> thick.
e. Zinc-Tin Alloy-Coated Copper:  [20 oz./sq. ft.(0.68 mm thick)] <Insert weight(thickness)>.
f. Galvanized Steel:  [0.034 inch(0.86 mm)] <Insert thickness> thick.
g. Aluminum-Zinc Alloy-Coated Steel:  [0.034 inch(0.86 mm)] <Insert thickness> thick.
h. Zinc:  [0.048 inch(1.25 mm)] [0.059 inch(1.50 mm)] <Insert thickness> thick.

7. Gutters with Girth 26 to 30 Inches(660 to 760 mm):  Fabricate from the following materials:

a. Copper:  [24 oz./sq. ft.(0.82 mm thick)] <Insert weight(thickness)>.
b. Aluminum:  [0.063 inch(1.60 mm)] <Insert thickness> thick.
c. Stainless Steel:  [0.031 inch(0.79 mm)] <Insert thickness> thick.
d. Zinc-Tin Alloy-Coated Copper:  [24 oz./sq. ft.(0.82 mm thick)] <Insert weight(thickness)>.
e. Galvanized Steel:  [0.040 inch(1.02 mm)] <Insert thickness> thick.
f. Aluminum-Zinc Alloy-Coated Steel:  [0.040 inch(1.02 mm)] <Insert thickness> thick.

8. Gutters with Girth 31 to 35 Inches(790 to 890 mm):  Fabricate from the following materials:

a. Copper:  [24 oz./sq. ft.(0.82 mm thick)] <Insert weight(thickness)>.
b. Stainless Steel:  [0.038 inch(0.95 mm)] <Insert thickness> thick.
c. Zinc-Tin Alloy-Coated Copper:  [25 oz./sq. ft.(0.87 mm thick)] <Insert weight(thickness)>.
d. Galvanized Steel: \(0.052 \text{ inch}(1.32 \text{ mm})\) <Insert thickness> thick.
e. Aluminum-Zinc Alloy-Coated Steel: \(0.052 \text{ inch}(1.32 \text{ mm})\) <Insert thickness> thick.

B. Built-in Gutters: Fabricate to cross section indicated, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96-inch-(2400-mm-) long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.

1. Fabricate gutters with built-in expansion joints and gutter-end expansion joints at walls.
2. Accessories: Continuous removable leaf screen with sheet metal frame and hardware cloth screen] [Bronze wire ball downspout strainer] [Wire ball downspout strainer].
3. Fabricate from the following materials:
   a. Copper: \([16 \text{ oz./sq. ft.}(0.55 \text{ mm thick})]\) <Insert weight(thickness)>.
   b. Stainless Steel: \([0.016 \text{ inch}(0.40 \text{ mm})]\) <Insert thickness> thick.
   c. Zinc-Tin Alloy-Coated Stainless Steel: \([0.015 \text{ inch}(0.38 \text{ mm})]\) <Insert thickness> thick.
   d. Zinc-Tin Alloy-Coated Copper: \([16 \text{ oz./sq. ft.}(0.55 \text{ mm thick})]\) <Insert weight(thickness)>.
   e. Zinc: \([0.032 \text{ inch}(0.80 \text{ mm})]\) \([0.039 \text{ inch}(1.00 \text{ mm})]\) <Insert thickness> thick.

C. Downspouts: Fabricate [round] [rectangular] [open-face] downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

2. Manufactured Hanger Style: SMACNA figure designation \([1-34A]\) \([1-34B]\) \([1-34C]\) \([1-34D]\) \([1-34E]\).
3. Hanger Style: <Insert description>.
4. Fabricate from the following materials:
   a. Copper: \([16 \text{ oz./sq. ft.}(0.55 \text{ mm thick})]\) <Insert weight(thickness)>.
   b. Aluminum: \([0.024 \text{ inch}(0.61 \text{ mm})]\) <Insert thickness> thick.
   c. Stainless Steel: \([0.016 \text{ inch}(0.40 \text{ mm})]\) <Insert thickness> thick.
   d. Zinc-Tin Alloy-Coated Stainless Steel: \([0.015 \text{ inch}(0.38 \text{ mm})]\) <Insert thickness> thick.
   e. Zinc-Tin Alloy-Coated Copper: \([16 \text{ oz./sq. ft.}(0.55 \text{ mm thick})]\) <Insert weight(thickness)>.
   f. Galvanized Steel: \([0.022 \text{ inch}(0.56 \text{ mm})]\) <Insert thickness> thick.
   g. Aluminum-Zinc Alloy-Coated Steel: \([0.022 \text{ inch}(0.56 \text{ mm})]\) <Insert thickness> thick.
   h. Zinc: \([0.032 \text{ inch}(0.80 \text{ mm})]\) \([0.039 \text{ inch}(1.00 \text{ mm})]\) <Insert thickness> thick.

D. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch-(100-mm-) wide wall flanges to interior, and base extending 4 inches(100 mm) beyond cant or tapered strip into field of roof.[ Fasten gravel guard angles to base of scupper.] Fabricate from the following materials:

1. Copper: \([16 \text{ oz./sq. ft.}(0.55 \text{ mm thick})]\) <Insert weight(thickness)>.
2. Aluminum: \([0.032 \text{ inch}(0.81 \text{ mm})]\) <Insert thickness> thick.
3. Stainless Steel: \([0.019 \text{ inch}(0.48 \text{ mm})]\) <Insert thickness> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: \([0.018 \text{ inch}(0.46 \text{ mm})]\) <Insert thickness> thick.
5. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight(thickness)>.
6. Galvanized Steel: [0.028 inch (0.71 mm)] <Insert thickness> thick.
7. Aluminum-Zinc Alloy-Coated Steel: [0.028 inch (0.71 mm)] <Insert thickness> thick.
8. Zinc: [0.032 inch (0.80 mm)] [0.039 inch (1.00 mm)] <Insert thickness> thick.

E. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:

1. Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight(thickness)>.
2. Aluminum: [0.032 inch (0.81 mm)] <Insert thickness> thick.
3. Stainless Steel: [0.016 inch (0.40 mm)] <Insert thickness> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: [0.015 inch (0.38 mm)] <Insert thickness> thick.
5. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight(thickness)>.
6. Galvanized Steel: [0.028 inch (0.71 mm)] <Insert thickness> thick.
7. Aluminum-Zinc Alloy-Coated Steel: [0.028 inch (0.71 mm)] <Insert thickness> thick.
8. Zinc: [0.032 inch (0.80 mm)] [0.039 inch (1.00 mm)] <Insert thickness> thick.

F. Splash Pans: Fabricate from the following materials:

1. Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight(thickness)>.
2. Aluminum: [0.040 inch (1.02 mm)] <Insert thickness> thick.
3. Stainless Steel: [0.019 inch (0.48 mm)] <Insert thickness> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: [0.018 inch (0.46 mm)] <Insert thickness> thick.
5. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight(thickness)>.
6. Zinc: [0.032 inch (0.80 mm)] [0.039 inch (1.00 mm)] <Insert thickness> thick.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-(2400-mm-) long, but not exceeding 10-foot-(3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates.

1. Joint Style: Butt, with 12-inch- (300-mm-) wide, concealed backup plate and 6-inch- (150-mm-) wide, exposed cover plates.
2. Fabricate from the following materials:
   a. Galvanized Steel: 0.028 inch (0.71 mm) thick.

B. Copings: Fabricate in minimum 96-inch-(2400-mm-) long, but not exceeding 10-foot-(3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, seal, and solder or weld watertight.

1. Coping Profile: SMACNA figure designation 3-4A
2. Joint Style: Butt, with 12-inch- (300-mm-) wide, concealed backup plate and 6-inch- (150-mm-) wide, exposed cover plates.
3. Fabricate from the following materials:
   a. Galvanized Steel: 0.040 inch (1.02 mm) thick.
C. Counter-flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

D. Flashing Receivers: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

2.6 WALL SHEET METAL FABRICATIONS

A. Wall Expansion-Joint Cover: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
   4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
   5. Install sealant tape where indicated.
   6. Torch cutting of sheet metal flashing and trim is not permitted.
   7. Do not use graphite pencils to mark metal surfaces.
B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel sheet.

2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored [gutter brackets] [straps] [twisted straps] spaced not more than 36 inches (900 mm) apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.

2. Loosely lock straps to front gutter bead and anchor to roof deck.

3. Anchor and loosely lock back edge of gutter to continuous [cleat] [eave or apron flashing].

4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) <Insert dimension> apart.

5. Anchor gutter with spikes and ferrules spaced not more than 24 inches (600 mm) [30 inches (750 mm)] <Insert dimension> apart.

6. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) <Insert dimension> apart. Install expansion-joint caps.
7. Install continuous gutter screens on gutters with noncorrosive fasteners, [removable] [hinged to swing open] for cleaning gutters.

C. Built-in Gutters: Join sections with riveted and soldered or lapped joints sealed with sealant. Provide for thermal expansion. Slope to downspouts. Provide end closures and seal watertight with sealant.

1. Install felt underlayment layer in built-in gutter trough and extend to drip edge at eaves and under felt underlayment on roof sheathing. Lap sides a minimum of 2 inches (50 mm) over underlying course. Lap ends a minimum of 4 inches (100 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm). Fasten with roofing nails. Install slip sheet over felt underlayment.
2. Anchor and loosely lock back edge of gutter to continuous [cleat] [eave or apron flashing].
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
4. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.

D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system indicated.


F. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and [solder] [or] [seal with elastomeric sealant] to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. [Solder] [or] [seal with elastomeric sealant] exterior wall scupper flanges into back of conductor head.

G. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch (25 mm) below [scupper] [gutter] discharge.

H. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 24-inch (600-mm) centers.

D. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock exterior and interior bottom edge of coping with continuous cleats anchored to substrate at 24-inch (600-mm) centers.

E. Pipe or Post Counter-flashing: Install counter-flashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

F. Counter-flashing: Coordinate installation of counter-flashing with installation of base flashing. Insert counter-flashing in reglets or receivers and fit tightly to base flashing. Extend counter-flashing 4 inches (100 mm) over base flashing. Lap counter-flashing joints a minimum of 4 inches (100 mm) and bed with sealant. Secure in a waterproof manner by means of interlocking folded seam or blind rivets and sealant.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On
completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07620
SECTION 07920 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes joint sealants for the following applications:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   b. Joints between plant-precast architectural concrete units.
   c. Control and expansion joints in unit masonry.
   d. Joints in dimension stone cladding.
   e. Joints in glass unit masonry assemblies.
   f. Joints in exterior insulation and finish systems.
   g. Joints between metal panels.
   h. Joints between different materials listed above.
   i. Perimeter joints between materials listed above and frames of doors, windows and louvers.
   j. Control and expansion joints in ceilings and other overhead surfaces.
   k. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces:
   a. Control and expansion joints in brick pavers.
   b. Isolation and contraction joints in cast-in-place concrete slabs.
   c. Joints between plant-precast architectural concrete paving units.
   d. Joints in stone paving units, including steps.
   e. Tile control and expansion joints.
   f. Joints between different materials listed above.
   g. Other joints as indicated.

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Tile control and expansion joints.
   d. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls and partitions.
   e. Joints on underside of plant-precast structural concrete beams and planks.
   f. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
   g. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   h. Other joints as indicated.

4. Interior joints in the following horizontal traffic surfaces:
b. Control and expansion joints in stone flooring.
c. Control and expansion joints in brick flooring.
d. Control and expansion joints in tile flooring.
e. Other joints as indicated.

B. Related Sections include the following:

1. Division 2 Section "Pavement Joint Sealants" for sealing joints in pavements, walkways, and curbing.
2. Division 4 Section "Unit Masonry Assemblies" for masonry control and expansion joint fillers and gaskets.
3. Division 7 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
4. Division 8 Section "Glazing" for glazing sealants.
5. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
6. Division 9 Section "Ceramic Tile" for sealing tile joints.
7. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Multicomponent Nonsag Neutral-Curing Silicone Sealant

1. Products:
   a. Dow Corning Corporation; 756 H.P.

2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.

E. Single-Component Pourable Neutral-Curing Silicone Sealant

1. Products:
   a. Dow Corning Corporation; 890-SL.
   b. Pecora Corporation; 300 Pavement Sealant (Self Leveling).
   c. Dow Corning Corporation; SL Parking Structure Sealant.

2. Type and Grade: S (single component) and P (pourable).
3. Class: 100/50.
4. Use Related to Exposure: NT and T (traffic).
5. Uses Related to Joint Substrates: M, A and O.
F. Single-Component Neutral-Curing Silicone Sealant

1. Products:
   a. Dow Corning Corporation; 790.
   b. GE Silicones; SilPruf LM SCS2700.
   c. GE Silicones; SilPruf SCS2000.
   d. Pecora Corporation; 864.
   e. Pecora Corporation; 890.
   g. Sonneborn, Division of ChemRex Inc.; Omniseal.
   h. Tremco; Spectrem 3.
   i. Dow Corning Corporation; 791.
   j. Dow Corning Corporation; 795
   k. GE Silicones; SilPruf NB SCS9000.
   l. GE Silicones; UltraPruf II SCS2900.
   m. Pecora Corporation; 865.
   n. Pecora Corporation; 895.
   o. Pecora Corporation; 898.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 100/50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.

G. Single-Component Neutral-Curing Silicone Sealant

1. Products:
   a. Dow Corning Corporation; 799.
   b. GE Silicones; UltraGlaze SSG4000.
   c. GE Silicones; UltraGlaze SSG4000AC.
   f. Tremco; ProGlaze SG.
   g. Tremco; Spectrem 2.
   h. Tremco; Tremsil 600.

2. Type and Grade: S (single component) and NS (nonsag).
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.

H. Multicomponent Nonsag Urethane Sealant

1. Products:
   b. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
   c. Sonneborn, Division of ChemRex Inc.; NP 2.
   d. Tremco; Vulkem 227.
e. Tremco; Vulkem 322 DS.
2. Type and Grade: M (multicomponent) and NS (nonsag).
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.

I. Multicomponent Nonsag Urethane Sealant

1. Products:
   a. Bostik Findley; Chem-Calk 500.
   b. Pacific Polymers, Inc.; Elasto-Thane 227 R Type II (Gun Grade).
   c. Polymeric Systems Inc.; PSI-270.
   d. Tremco; Dymeric.
2. Type and Grade: M (multicomponent) and NS (nonsag).
4. Additional Movement Capability: 40 percent movement in extension and 25 percent in compression for a total of 65 percent movement.
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M and A.

J. Multicomponent Pourable Urethane Sealant

1. Products:
   a. Pecora Corporation; Dynatrol II-SG.
   b. Sika Corporation, Inc.; Sikaflex - 2c SL.
   c. Sonneborn, Division of ChemRex Inc.; SL 2.
2. Type and Grade: M (multicomponent) and P (pourable).
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A and O.

K. Single-Component Nonsag Urethane Sealant

1. Products:
   b. Sonneborn, Division of ChemRex Inc.; Ultra.
   c. Sonneborn, Division of ChemRex Inc.; NP 1.
   d. Tremco; Vulkem 116.
2. Type and Grade: S (single component) and NS (nonsag).
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G and O.

L. Single-Component Pourable Urethane Sealant

1. Products:
   a. Sika Corporation, Inc.; Sikaflex - 1CSL.
b. Sonneborn, Division of ChemRex Inc.; SL 1.
c. Tremco; Vulkem Nova 300 SSL.

2. Type and Grade: S (single component) and P (pourable).
3. Class: 25
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).

2.4 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Products:

4. Sonneborn, Division of ChemRex Inc.; Sonolac.
5. Tremco; Tremflex 834.

2.5 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
2. Products:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.

B. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

1. Products:
   a. Pecora Corporation; BA-98.
   b. Tremco; Tremco Acoustical Sealant.

2.6 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), O (open-cell material), B (bicellular material with a surface skin, or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size
and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer’s written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include, but are not limited to, the following:

   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include, but are not limited to, the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform...
beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
   a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07920
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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1  GENERAL
1.01  RELATED REQUIREMENTS
   A. Section 09 91 23 - Interior Painting: Identification painting.
   B. Section 22 60 05 - Medical Air, Gas, and Vacuum Systems: Supply of pipe labels for placement under this section.

PART 2  PRODUCTS
2.01  IDENTIFICATION APPLICATIONS
   A. Air Handling Units: Nameplates.
   B. Air Terminal Units: Tags.
   C. Automatic Controls: Tags. Key to control schematic.
   D. Control Panels: Nameplates.
   E. Ductwork: Nameplates.
   F. Major Control Components: Nameplates.
   G. Piping: Tags.
   H. Pumps: Nameplates.
   I. Small-sized Equipment: Tags.
   J. Tanks: Nameplates.
   K. Thermostats: Nameplates.

2.02  NAMEPLATES
   A. Description: Laminated three-layer plastic with engraved letters.
      1. per UT specifications.

2.03  TAGS

2.04  STENCILS

2.05  PIPE MARKERS

2.06  CEILING TACKS
   A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
   B. Color code as follows:
      1. HVAC Equipment: Yellow.
      2. Fire Dampers and Smoke Dampers: Red.

PART 3  EXECUTION
3.01  INSTALLATION

END OF SECTION
SECTION 22 07 16 - PLUMBING EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Equipment insulation.

1.02 RELATED REQUIREMENTS
A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
B. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.
C. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
D. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS
B. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2013.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

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.

END OF SECTION
SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Piping insulation.
   B. Jackets and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 07 84 00 - Firestopping.
   B. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.
   C. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
   C. 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 __________ 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:
5. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
1. Aeroflex USA, Inc; ______:  www.aeroflexusa.com.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).

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. 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.
C. 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.

3.03 SCHEDULES

A. Plumbing Systems:
   1. Domestic Hot Water Supply:
      a. Expanded Polystyrene Insulation:
         1) Pipe Size Range: 1/2 inch (____ mm).
         2) Thickness: 1 inch (____ mm).
      2. Domestic Hot Water Recirculation:
         a. Polyethylene Insulation:
            1) Pipe Size Range: All sizes.
            2) Thickness: 1 inch (25 mm).
      3. Domestic Cold Water:

END OF SECTION
SECTION 22 10 05 - PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Sanitary sewer.
   2. Domestic water.
   4. Pipe hangers and supports.
   5. Valves.
   6. Relief valves.

1.02 RELATED REQUIREMENTS

A. Section 31 23 16 - Excavation.
B. Section 31 23 23 - Fill.
C. Section 31 23 16.13 - Trenching.
D. Section 33 13 00 - Disinfecting of Water Utility Distribution.
E. Section 07 84 00 - Firestopping.
F. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.
G. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
H. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
I. Section 22 07 19 - Plumbing Piping Insulation.
J. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.
K. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.
L. Section 31 23 16 - Excavation.
M. Section 33 13 00 - Disinfecting of Water Utility Distribution.

1.03 REFERENCE STANDARDS

E. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2011.
F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
H. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; 2012.
J. ASME B31.2 - Fuel Gas Piping; The American Society of Mechanical Engineers; 1968.
K. ASME B31.9 - Building Services Piping; 2014.
R. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
AA. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
AB. AWWA C651 - Disinfecting Water Mains; 2005.
AD. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.
AE. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.
AF. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
C. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE
A. Perform Work in accordance with State of Texas, standards and U.T.requirements.
   1. Maintain one copy on project site.
B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.06 REGULATORY REQUIREMENTS
A. Perform Work in accordance with State of Texas plumbing code.
B. Conform to applicable code for installation of backflow prevention devices.
C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.
1.07 DELIVERY, STORAGE, AND HANDLING
   A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

1.08 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.

2.02 SANITARY SEWER PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING
   A. PVC Pipe: ASTM D2665 or ASTM D3034.
      1. Fittings: PVC.

2.03 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING
   A. PVC Pipe: ASTM D2665 or ASTM D3034.
      1. Fittings: PVC.

2.04 SANITARY SEWER PIPING, ABOVE GRADE
   A. PVC Pipe: ASTM D2729.
      1. Fittings: PVC.

2.05 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING
   A. Copper Pipe: ASTM B42, hard drawn.
      1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2.06 DOMESTIC WATER PIPING, ABOVE GRADE
   A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
      1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
      2. Mechanical Press Sealed Fittings: Double pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.

2.07 NATURAL GAS PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING
   A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
      1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.08 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING
   A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
      3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.09 NATURAL GAS PIPING, ABOVE GRADE
   A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
      2. Joints: Threaded or welded to ASME B31.1.

2.10 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 and U.T, requirements.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.

B. Plumbing Piping - Drain, Waste, and Vent:

C. Plumbing Piping - Water:

2.11 GATE VALVES

A. Manufacturers:
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 3 Inches (80 mm):
1. MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder ends.

C. 2 Inches (50 mm) and Larger:
1. MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain-wheel operators for valves 6 inches (150 mm) and larger mounted over 8 feet (2400 mm) above floor.

2.12 BALL VALVES

A. Manufacturers:
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

2.13 WATER PRESSURE REDUCING VALVES:

2.14 RELIEF VALVES

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 maintain headroom, conserve space, and not interfere with use of space.
E. Group piping whenever practical at common elevations.
F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
H. Provide access where valves and fittings are not exposed.
I. Provide support for utility meters in accordance with requirements of utility companies.
J. Excavate in accordance with Section 31 23 16.
K. Backfill in accordance with Section 31 23 23.
L. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
M. Sleeve pipes passing through partitions, walls and floors.
N. 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 (100 mm).
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
O. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
   3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
   4. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   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.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM
A. Disinfect water distribution system in accordance with Section 33 13 00.
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.

END OF SECTION
SECTION 22 10 06 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.
B. Roof and floor drains.
C. Cleanouts.
D. Hose bibbs.
E. Backflow preventers.
F. Water hammer arrestors.
G. Thermostatic mixing valves.

1.02 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping.
B. Section 22 40 00 - Plumbing Fixtures.
C. Section 22 30 00 - Plumbing Equipment.
D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

B. ASME A112.6.3 - Floor and Trench Drains; 2001 (R2007).
C. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2003.
E. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; 2009.
F. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
C. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
D. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

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.

2.02 DRAINS
   A. Manufacturers:
      1. Wade; Model Series W-3000;
      2. Substitutions: See Section 01 60 00 - Product Requirements.
   B. Roof Drains:
      1. Assembly: ASME A112.6.4.
      2. Accessories: Coordinate with roofing type,
   C. Floor Drain (FD-2):

2.03 CLEANOUTS

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install in accordance with manufacturer's instructions.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water closets.
B. Urinals.
C. Lavatories.
D. Sinks.
E. Service sinks.
F. Electric water coolers.
G. Bathtubs.
H. Showers.
I. Eye and face wash fountains.
J. Emergency showers.

1.02 RELATED REQUIREMENTS

A. Section 07 90 05 - Joint Sealers: Seal fixtures to walls and floors.
B. Section 22 10 05 - Plumbing Piping.
C. Section 22 10 06 - Plumbing Piping Specialties.
D. Section 22 30 00 - Plumbing Equipment.
E. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

C. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2002).
D. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
F. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures; The American Society of Mechanical Engineers; 2008 (R2011).
G. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2013.
H. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use); 2008 (R2013).
I. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; 1994 (R2004).
J. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2011.
K. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2004.
M. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).

1.04 SUBMITTALS SEE MEP SCHEDULES

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
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 Owners name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for Owners use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Faucet Washers: One set of each type and size.
   3. Extra Shower Heads: One of each type and size.
   4. Extra Toilet Seats: One of each type and size.
   5. Flush Valve Service Kits: One for each type and size.

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 REGULATORY REQUIREMENTS

   A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 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.

1.08 WARRANTY

   A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS SEE MEP SCHEDULES

2.01 GENERAL

   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.

2.02 TANK TYPE WATER CLOSETS

   A. Tank Type Water Closet Manufacturers:

2.03 WALL HUNG URINALS SEE MEP SCHEDULES

      1. Flush Volume: 1.0 gallons (3.7 liters), maximum.
      2. Flush Valve: Exposed (top spud).
      4. Trap: Integral.
   B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
      1. Sensor-Operated Type: Solenoid operator, low voltage hard-wired, infrared sensor and over-ride push button.
      2. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.

2.04 LAVATORIES SEE MEP SCHEDULES

   A. Lavatory Manufacturers:

   B. White Vitreous China Under-Mount Basin: ASME A112.19.2; vitreous china under-mount lavatory, front overflow, mounting kit and template by manufacturer.

   C. Supply Faucet:
1. ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum 2.0 gpm (7.5 L/m) flow, indexed handles.

D. Accessories:
   1. Chrome plated 17 gage, 0.0538 inch (1.37 mm) brass P-trap with clean-out plug and arm with escutcheon.
   2. Offset waste with perforated open strainer.

2.05 SINKS SEE MEP SCHEDULES
   A. Sink Manufacturers:
      1. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 BATHTUBS AND SHOWERS SEE MEP SCHEDULES
2.07 SHOWER RECEPTORS SEE MEP SCHEDULES
2.08 DRINKING FOUNTAINS
2.09 ELECTRIC WATER COOLERS SEE MEP SCHEDULES
2.10 SERVICE SINKS SEE MEP SCHEDULES
2.11 EMERGENCY EYE AND FACE WASH
   A. Emergency Wash: ANSI Z358.1; wall-mounted, self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads and face spray ring, stainless steel dust cover, copper alloy control valve and fittings.

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. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 05, color to match fixture.
   F. 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.

   END OF SECTION
SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Nameplates.
B. Tags.
C. Stencils.
D. Pipe markers.
E. Ceiling tacks.

1.02  REFERENCE STANDARDS

1.03  SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

PART 2  PRODUCTS

2.01  IDENTIFICATION APPLICATIONS
A. Air Handling Units: Nameplates.
B. Air Terminal Units: Tags.
C. Automatic Controls: Tags. Key to control schematic.
D. Control Panels: Nameplates.
E. Dampers: Ceiling tacks, where located above lay-in ceiling.
F. Ductwork: Nameplates.
H. Instrumentation: Tags.
I. Major Control Components: Nameplates.
J. Piping: Tags.
K. Pumps: Nameplates.
L. Tanks: Nameplates.
M. Thermostats: Nameplates.
N. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.02  NAMEPLATES

2.03  TAGS

2.04  STENCILS
A. Stencils: With clean cut symbols and letters of following size:

2.05  PIPE MARKERS

2.06  CEILING TACKS
A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Testing, adjustment, and balancing of air systems.
B. Measurement of final operating condition of HVAC systems.
C. Commissioning activities.

1.02 RELATED REQUIREMENTS
A. Section 01 91 13 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
B. Section 23 08 00 - Commissioning of HVAC.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
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. Submit to the Commissioning Authority.
   2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   4. 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. Identification and types of measurement instruments to be used and their most recent calibration date.
      d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      e. Final test report forms to be used.
      f. Detailed step-by-step procedures for TAB work for each system and issue, including:
         1) Terminal flow calibration (for each terminal type).
         2) Diffuser proportioning.
         3) Branch/submain proportioning.
         4) Total flow calculations.
         5) Rechecking.
         6) Diversity issues.
      g. Details of how TOTAL flow will be determined; for example:
         1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
         2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
h. Confirmation of understanding of the outside air ventilation criteria under all conditions.

i. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).

j. Method of checking building static and exhaust fan and/or relief damper capacity.

k. Methods for making coil or other system plant capacity measurements, if specified.

l. Time schedule for TAB work to be done in phases (by floor, etc.).

m. Description of TAB work for areas to be built out later, if any.

n. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.

o. Interstitial cavity differential pressure measurements and calculations, if specified.

p. Procedures for formal progress reports, including scope and frequency.

q. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

D. Progress Reports.

E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

2. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

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.

6. Include the following on the title page of each report:
   a. Name of Testing, Adjusting, and Balancing Agency.
   b. Address of Testing, Adjusting, and Balancing Agency.
   c. Telephone number of Testing, Adjusting, and Balancing Agency.
   d. Project name.
   e. Project location.
   f. Project Architect.
   g. Project Engineer.MEP Associates
   h. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:


B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. 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. Hold a pre-balancing meeting at least one week prior to starting TAB work.

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.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the owner representative.

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. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
H. 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.
I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
L. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.07 COMMISSIONING
A. See Sections 01 91 13 and 23 08 00 for additional requirements.
B. Perform prerequisites prior to starting commissioning activities.
C. Fill out Prefunctional Checklists for:
   1. Air side systems.
   2. Water side systems.
D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
E. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for ____ percent of the air handlers plus a random sample equivalent to ____ percent of the final TAB report data as directed by Commissioning Authority.
   1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
   2. Use the same test instruments as used in the original TAB work.
   3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
   4. For purposes of re-check, failure is defined as follows:
      a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
      b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
      c. Temperatures: Deviation of more than one degree F (0.5 degree C).
      d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.

5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.

F. In the presence of the Commissioning Authority, verify that:
   1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
   2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
   3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.08 SCOPE
A. Test, adjust, and balance the following:
   1. Plumbing Pumps.
   2. HVAC Pumps.
   3. Packaged Roof Top Heating/Cooling Units.
   4. Induction Units.
   5. Air Handling Units.
   6. Fans.
   7. Air Filters.
   8. Air Terminal Units.

END OF SECTION
SECTION 23 07 13 - DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Duct insulation.
B. Insulation jackets.

1.02 RELATED REQUIREMENTS
A. Section 07 84 00 - Firestopping.
B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
C. Section 23 05 53 - Identification for HVAC Piping and Equipment.
D. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS
G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

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.
B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum __________ years of experience and approved by manufacturer.

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.
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, FLEXIBLE
A. Manufacturer:
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. 'K' ('Ksi') value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C518.

2.03 JACKETS

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that ducts have been tested before 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. Insulated ducts conveying air below ambient temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
D. Insulated ducts conveying air above ambient temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor) ((below 3 meters above finished floor)): Finish with canvas jacket sized for finish painting.
F. External Duct Insulation Application:
   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. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
G. 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.
   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.
3.03 SCHEDULES

A. Exhaust Ducts Within 10 ft (3 m) of Exterior Openings:
B. Exhaust Ducts Exposed to Outdoor Air:
C. Supply Ducts:
D. Return and Relief Ducts.

END OF SECTION
**SECTION 23 08 00 - COMMISSIONING OF HVAC**

**PART 1 GENERAL**

1.01 SUMMARY

A. See Section 01 91 13 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 01 91 13.

B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.

D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
   1. Control system.
   2. Major and minor equipment items.
   3. Piping systems and equipment.
   4. Ductwork and accessories.
   5. Terminal units.
   8. Variable frequency drives.
   9. Special Ventilation:
      a. Fume hoods.
      b. Laboratory pressurization.
   10. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 RELATED REQUIREMENTS

A. Section 01 57 21 - Indoor Air Quality Controls: Precautions and procedures; smoking room testing; building flush-out.

B. Section 01 78 00 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

C. Section 01 79 00 - Demonstration and Training: Scope and procedures for personnel training.

D. Section 01 91 13 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

E. Section 23 09 43 - Pneumatic Control System for HVAC.

F. Section 23 09 23 - Direct-Digital Control System for HVAC.

G. Section 23 09 13 - Instrumentation and Control Devices for HVAC.

H. Section 23 09 93 - Sequence of Operations for HVAC Controls.

I. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS


1.04 SUBMITTALS

A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
B. DRAFT Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
1. System name.
2. List of devices.
3. Step-by-step procedures for testing each controller after installation, including:
   a. Process of verifying proper hardware and wiring installation.
   b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
   c. Process of performing operational checks of each controlled component.
   d. Plan and process for calibrating valve and damper actuators and all sensors.
   e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.
5. Description of the instrumentation required for testing.
6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.

D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
2. Full as-built set of control drawings.
3. Full as-built sequence of operations for each piece of equipment.
4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
   a. Floor.
   b. Room number.
   c. Room name.
   d. Air handler unit ID.
   e. Reference drawing number.
   f. Air terminal unit tag ID.
   g. Heating and/or cooling valve tag ID.
   h. Minimum air flow rate.
   i. Maximum air flow rate.
5. Full print out of all schedules and set points after testing and acceptance of the system.
6. Full as-built print out of software program.
7. Electronic copy on disk of the entire program for this facility.
8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
9. Control equipment component submittals, parts lists, etc.
10. Warranty requirements.
11. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
12. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
a. Sequences of operation.
b. Control drawings.
c. Points lists.
d. Controller and/or module data.
e. Thermostats and timers.
f. Sensors and DP switches.
g. Valves and valve actuators.
h. Dampers and damper actuators.
i. Program setups (software program printouts).

E. Project Record Documents: See Section 01 78 00 for additional requirements.
   1. Submit updated version of control system documentation, for inclusion with operation and
      maintenance data.
   2. Show actual locations of all static and differential pressure sensors (air, water and building
      pressure) and air-flow stations on project record drawings.

F. Training Manuals: See Section 01 79 00 for additional requirements.
   1. Provide three extra copies of the controls training manuals in a separate manual from the
      O&M manuals.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT
A. Provide all standard testing equipment required to perform startup and initial checkout and
   required functional performance testing; unless otherwise noted such testing equipment will
   NOT become the property of [].
B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific
   to a piece of equipment, are only available from the vendor, and are required in order to
   accomplish startup or Functional Testing, provide such equipment, tools, and instruments as
   part of the work at no extra cost to []; such equipment, tools, and instruments are to become the
   property of .

PART 3 EXECUTION

3.01 PREPARATION
A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and
   Functional Test Procedures.
B. Furnish additional information requested by the Commissioning Authority.
C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning,
   equipment start-up and testing, adjusting, and balancing start and completion for use by the
   Commissioning Authority; update the schedule as appropriate.
D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning,
   startup of each piece of equipment and testing, adjusting, and balancing will occur; when
   commissioning activities not yet performed or not yet scheduled will delay construction notify
   ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling
   information needed to efficiently execute the commissioning process.
E. Put all HVAC equipment and systems into operation and continue operation during each
   working day of testing, adjusting, and balancing and commissioning, as required.
F. Provide test holes in ducts and plenums where directed to allow air measurements and air
   balancing; close with an approved plug.
G. Provide temperature and pressure taps in accordance with the contract documents.
   1. Provide a pressure/temperature plug at each water sensor that is an input point to the
      control system.

3.02 INSPECTING AND TESTING - GENERAL
A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment
   or other assembly to be commissioned.
B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.

C. Valve/Damper Stroke Setup and Check:
   1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
   2. Set pump/fan to normal operating mode.
   3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
   4. Command valve/damper open; verify position is full open and adjust output signal as required.
   5. Command valve/damper to a few intermediate positions.
   6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

D. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to owner

3.03 TAB COORDINATION
   A. TAB: Testing, adjusting, and balancing of HVAC.
   B. Coordinate commissioning schedule with TAB schedule.
   C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
   D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
   E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
   F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING
   A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submittal.
   B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with the contract documents.
   C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
   D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
      1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to owner
      2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
   E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
   F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
      1. Setpoint changing features and functions.
      2. Sensor calibrations.
G. Demonstrate to the Commissioning Authority:
   1. That all specified functions and features are set up, debugged and fully operable.
   2. That scheduling features are fully functional and setup, including holidays.
   3. That all graphic screens and value readouts are completed.
   4. Correct date and time setting in central computer.
   5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
   6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
   7. Power failure and battery backup and power-up restart functions.
   8. Global commands features.
   9. Security and access codes.
   10. Occupant over-rides (manual, telephone, key, keypad, etc.).
   11. O&M schedules and alarms.
   12. Occupancy sensors and controls.
   13. “After hours” use tracking and billing.
   14. Communications to remote sites.
   15. Fire alarm interlocks and response.
   16. Fire protection and suppression systems interfaces.
   17. Security system interlocks.
   18. That points that are monitored only, having no control function, are reporting properly to the control system.
   19. All control strategies and sequences not tested during controlled equipment testing.

H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 OPERATION AND MAINTENANCE MANUALS
   A. See Section 01 78 00 for additional requirements.
   B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
   C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
   D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.06 DEMONSTRATION AND TRAINING
   A. See Section 01 79 00 for additional requirements.
   B. Demonstrate operation and maintenance of HVAC system to Owner personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
   C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
   D. Provide classroom and hands-on training of Owner designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of train
   E. TAB Review: Instruct [] personnel for minimum 1.5 hours, after completion of TAB, on the following:
      1. Review final TAB report, explaining the layout and meanings of each data type.
2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
5. Other salient information that may be useful for facility operations, relative to TAB.

F. HVAC Control System Training: Perform training in at least three phases:
   1. Phase 1 - Basic Control System: Provide minimum of 4 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
      a. This training may be held on-site or at the manufacturer's facility.
      b. If held off-site, the training may occur prior to final completion of the system installation.
      c. For off-site training, Contractor shall pay expenses of up to two attendees.
   2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 8 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
      a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
      b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
      c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
      d. Every display screen, allowing time for questions.
      e. Use of keypad or plug-in laptop computer at the zone level.
      f. Use of remote access to the system via phone lines or networks.
      g. Setting up and changing an air terminal unit controller.
      h. Graphics generation.
      i. Point database entry and modifications.
      j. Understanding DDC field panel operating programming, when applicable.
   3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 8 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.

G. Provide the services of manufacturer representatives to assist instructors where necessary.
H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION
SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Metal ductwork.
   B. Duct cleaning.

1.02 RELATED REQUIREMENTS
   A. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
   B. Section 23 33 00 - Air Duct Accessories.
   C. Section 23 37 00 - Air Outlets and Inlets.
   D. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS
   B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
   H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.
   I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

1.04 PERFORMANCE REQUIREMENTS

1.05 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data for duct materials.

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

1.07 REGULATORY REQUIREMENTS
   A. Construct ductwork to NFPA 90A standards.

1.08 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 NFPA 90A standards.
B. Ducts: Galvanized steel, unless otherwise indicated.
C. Low Pressure Supply (Heating Systems): 1/2 inch w.g. (125 Pa) pressure class, galvanized steel.
D. Low Pressure Supply (System with Cooling Coils): 1/2 inch w.g. (125 Pa) pressure class, galvanized steel.
E. Fume Hood Exhaust: 1/2 inch w.g. (125 Pa) pressure class, galvanized steel.
F. Outside Air Intake: 1/2 inch w.g. (125 Pa) pressure class, galvanized steel.

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
B. Un-Galvanized Steel for Ducts: ASTM A1008/A1008M, Designation CS (commercial steel), cold-rolled.
C. Insulated Flexible Ducts:
   1. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
      a. Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
      b. Maximum Velocity: 4000 fpm (20.3 m/sec).
      c. Temperature Range: -10 degrees F to 160 degrees F (-23 degrees C to 71 degrees).

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. Provide air foil turning vanes when rectangular elbows must be used.
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).

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

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. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
D. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
F. Connect terminal units to supply ducts directly or with one foot (300 mm) maximum length of flexible duct. Do not use flexible duct to change direction.
G. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.

H. Connect flexible ducts to metal ducts with adhesive.

I. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

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
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Air turning devices/extractors.
B. Backdraft dampers - metal.
C. Backdraft dampers - fabric.
D. Backdraft dampers.
E. Combination fire and smoke dampers.
F. Duct access doors.
G. Duct test holes.
H. Fire dampers.
I. Flexible duct connections.
J. Smoke dampers.
K. Volume control dampers.

1.02 RELATED REQUIREMENTS
A. Section 07 84 00 - Firestopping.
B. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
D. Section 23 31 00 - HVAC Ducts and Casings.
E. Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.
F. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.
E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for shop fabricated assemblies including volume control dampers and hardware used. Include electrical characteristics and connection requirements.
C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers and duct test holes.
D. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

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. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS
A. Manufacturers:
   4. Note to Engineer: all manual and automatic volume dampers known to be required, including in the vertical, shall be shown in the plans.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

   B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

2.03 BACKDRAFT DAMPERS
A. Manufacturers:
   4. Furnish and install dampers where shown and wherever necessary for complete control. Where access to dampers through a fixed suspended ceiling is necessary, the Contractor shall be responsible for the proper location of the access doors.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 BACKDRAFT DAMPERS - FABRIC
A. Fabric Backdraft Dampers: Factory-fabricated.
   2. Birdscreen: 1/2 inch (12 mm) nominal mesh of galvanized steel or aluminum.
   3. Maximum Velocity: 1000 fpm (5 m/sec) face velocity.

2.05 COMBINATION FIRE AND SMOKE DAMPERS
A. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

2.06 DUCT ACCESS DOORS
A. Fabricate in accordance with SMACNA (DCS) and as indicated.

2.07 DUCT TEST HOLES

2.08 FIRE DAMPERS
A. Manufacturers:
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Ceiling Dampers: Galvanized steel, 22 gage (0.76 mm) frame and 16 gage (1.5 mm) flap, two layers 0.125 inch (3.2 mm) ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.

D. Horizontal Dampers: Galvanized steel, 22 gage (0.76 mm) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
2.09 FLEXIBLE DUCT CONNECTIONS
   A. Fabricate in accordance with SMACNA (DCS) and as indicated.
   B. Flexible Duct Connections: Fabric crimped into metal edging strip.

2.10 SMOKE DAMPERS
   A. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.

2.11 VOLUME CONTROL DAMPERS
   A. Manufacturers:
      2. Titus see MEP schedule.
      3. Substitutions: See Section 01 60 00 - Product Requirements.
   B. Fabricate in accordance with SMACNA (DCS) and as indicated.
   C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch (150 x 760 mm).

PART 3 EXECUTION

3.01 PREPARATION
   A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION
   A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 for duct construction and pressure class.
   B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
   C. Provide duct test holes where indicated and required for testing and balancing purposes.
   D. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
   E. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
   F. Demonstrate re-setting of fire dampers to [owners representative.
   G. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

END OF SECTION
SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Diffusers.
   B. Registers/grilles.
   C. Louvers.
   D. Goosenecks.

1.02 REFERENCE STANDARDS
   C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

1.03 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
   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. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

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.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   B. HART & COOLEY______.
   C. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ROUND CEILING DIFFUSERS

2.03 RECTANGULAR CEILING DIFFUSERS

2.04 LIGHT TROFFER DIFFUSERS
   A. Fabrication: Galvanized steel with welded or soldered joints and finish matte black inside.

2.05 CEILING SUPPLY REGISTERS/GRILLES
   A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.

2.06 CEILING EXHAUST AND RETURN REGISTERS/GRILLES
   A. Fabrication: Steel with 20 gage (0.90 mm) minimum frames and 22 gage (0.80 mm) minimum blades, steel and aluminum with 20 gage (0.90 mm) minimum frame, or aluminum extrusions, with factory off-white enamel finish .

2.07 LOUVERS

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install in accordance with manufacturer’s instructions.
B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. 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.

END OF SECTION
SECTION 23 38 13 - COMMERCIAL-KITCHEN HOODS

PART 2 PRODUCTS

1.01 HOOD APPLICATIONS

1.02 HOOD CONSTRUCTION

A. Provide products that comply with NFPA 96, the requirements and recommendations of SMACNA (KVS), and the requirements of the Authorities Having Jurisdiction.

B. Construction: Materials, inside and out, are stainless steel complying with ASTM A666, Type 304, stretcher leveled; unless otherwise indicated.

1. Sheet Thickness: 18 gage, 0.048 inch (1.22 mm), minimum.

2. Fabrication: Fabricate each individual hood in one piece, with all welds ground and finished to match (inside and out); fabricate flat surfaces exposed to view as double-pan formed panels with internal stiffener members.

3. Finish on Surfaces Exposed to View: No.4 (brushed directional); provide stainless steel faces on all sides exposed to view.

4. Finish on Concealed Surfaces: No.4 or No.2B (dull, matte).

5. Duct Collars: For exhaust and make-up air openings, provide duct collar welded to hood unit; minimum of 8 inches (200 mm) extension from top or back face of unit, with minimum one inch (25 mm) 90 degree flange, unless otherwise indicated.

6. Access Panels: Provide removable or hinged access panels sufficient for maintenance and replacement of operating components inside unit; maximum width of 40 inches (1000 mm).

7. Supports: Stainless steel mounting brackets, struts, and threaded hanger rods.
   a. Hanger Rods: 3/8 inch (9 mm) diameter, minimum.
   b. Hanger Spacing: 48 inches (1220 mm) on center, maximum.
   c. Attachment to Structure: Mechanical fittings or inserts, stainless steel.

1.03 HOOD ACCESSORIES

A. Controls:
   1. Fans: Provide manual push button controls for starting and stopping fans and labeled indicator lights showing fan status.
   2. Fans: Provide controls for fan operation by time clock, programmable by the week, capable of maintaining time cycle after operation of manual push buttons.

B. Control Panels: Factory assembled and pre-wired, ready for utility connections.
   1. UL listed for use with specific hood.
   2. Provide a single control panel combining all control functions for a particular hood, unless otherwise indicated.
   3. Provide a single control panel for each group of hoods served by a single exhaust fan.
   5. Provide indicator lights on control panel door showing status of fans and power supply.

END OF SECTION
PART 1  GENERAL
1.01  PERFORMANCE REQUIREMENTS
   A.  Conform to AHRI 850 Section 7.4.

1.02  SUBMITTALS
   A.  See Section 01 30 00 - Administrative Requirements for submittal procedures.

PART 2  PRODUCTS
PART 3  EXECUTION
3.01  INSTALLATION
   A.  Install air cleaning devices in accordance with manufacturer's instructions.
   B.  Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
   C.  Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES
A. Air-source heat pumps.
B. Air cooled condensing units.
C. Indoor air handler (fan & coil) units for duct connection.
D. Controls.

1.02  RELATED REQUIREMENTS
A. Section 22 10 05 - Plumbing Piping: Includes indoor coil condensate drain, water supply for humidifier, and ______________.
B. Section 23 31 00 - HVAC Ducts and Casings.
C. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats, humidistats, time clocks.
D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections and installation and wiring of thermostats and other controls components.

1.03  REFERENCE STANDARDS
B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
D. NEMA MG 1 - Motors and Generators; 2014.

1.04  SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
C. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
D. Project Record Documents: Record actual locations of components and connections.
E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
F. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
G. Maintenance Materials: Furnish the following for [ ] use in maintenance of project.
   1. Extra Filters: One for each unit.

1.05  QUALITY ASSURANCE
A. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience and approved by manufacturer.

1.06  WARRANTY
A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
PART 2 PRODUCTS

2.01 MANUFACTURERS SEE MEP SCHEDULES
   A. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SYSTEM DESIGN
   A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
      1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator; auxiliary electric heat.
      2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
   B. Performance Requirements: See Drawings for additional requirements.
   C. Electrical Characteristics: see MEP Schedules
      1. ____ kW.
      2. 208 volts, single phase, 60 Hz.
      3. ____ amperes maximum fuse size.
      4. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 27 17.

2.03 INDOOR UNITS FOR DUCTED SYSTEMS
   A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
      1. Air Flow Configuration: upflow and/or horizontal.
      2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
   B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
      1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.
      2. Motor Electrical Characteristics:
   C. Air Filters: 1 inch (25 mm) thick meets TxDADS requirements type arranged for easy replacement.
   D. 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.

2.04 OUTDOOR UNITS HEAT PUMP SEE MEP SCHEDULES
   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-410A.
      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. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
   C. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).
1. Provide thermostatic expansion valves.
2. Provide heat pump reversing valves.

D. Operating Controls:
1. Control by room thermostat to maintain room temperature setting.

2.05 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: see MEP Schedules
   a. Time of day.
   b. Actual room temperature.
4. Manufacturers: (see MEP schedules for unit specifications)
   a. Substitutions: See Section 01 60 00 - Product Requirements.

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.

END OF SECTION
SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Single conductor building wire.
B. Wire and cable for 600 volts and less.
C. Wiring connectors.
D. Electrical tape.
E. Wire pulling lubricant.
F. Cable ties.

1.02  RELATED REQUIREMENTS
A. Section 07 84 00 - Firestopping.
B. Section 31 23 16 - Excavation.
C. Section 31 23 23 - Fill: Bedding and backfilling.
D. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03  REFERENCE STANDARDS
F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.04  SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for each cable assembly type.
1.05 QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70.

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.
   C. Concealed Dry Interior Locations: Use only building wire in raceway or building wire with Type THHN insulation in raceway.
   D. Above Accessible Ceilings: Use only building wire in raceway or building wire with Type THHN insulation in raceway.
   E. Wet or Damp Interior Locations: Use only building wire with Type ___THW___ insulation in raceway.
   F. Exterior Locations: Use only building wire with Type __THW___ insulation in raceway.
   G. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
   H. Use stranded conductors for control circuits.
   I. Use conductor not smaller than 12 AWG for power and lighting circuits.
   J. Use conductor not smaller than 16 AWG for control circuits.
   K. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).
   L. Conductor sizes are based on copper unless indicated as aluminum or "AL".

2.02 CONDUCTOR AND CABLE MANUFACTURERS
   D. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 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. 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.
   H. Minimum Conductor Size:
      1. Branch Circuits: 12 AWG.
      2. Control Circuits: 14 AWG.
I. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

J. 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. 240/120 V High-Leg Delta, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B (High-Leg): Orange.
         3) Phase C: Blue.
         4) Neutral/Grounded: White.
      d. 240/120 V, 1 Phase, 3 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Neutral/Grounded: White.
      e. Equipment Ground, All Systems: Green.
      f. Isolated Ground, All Systems: Green with yellow stripe.
      g. Travelers for 3-Way and 4-Way Switching: Pink.
      h. 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.
      i. For control circuits, comply with manufacturer's recommended color code.

2.04 SINGLE CONDUCTOR BUILDING WIRE
   A. Description: Single conductor insulated wire.
   B. Conductor Strand:
      1. Feeders and Branch Circuits:
         b. Size 8 AWG and Larger: Stranded.
   C. Insulation Voltage Rating: 600 V.
   D. Insulation:
      1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
   E. Conductor: Copper.
   F. Insulation Voltage Rating: 600 volts.
   G. Insulation: NFPA 70, Type THW.

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.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

C. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

D. Mechanical Connectors: Provide bolted type or set-screw type.

E. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.06 WIRING ACCESSORIES

A. Electrical Tape:
   1. Manufacturers:
   2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
   3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).

B. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

C. Cable Ties: Material and tensile strength rating suitable for application.

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 raceway installation is complete and supported.
E. Verify that field measurements are as shown on the drawings.
F. 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 and routing is not shown, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location shown.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.

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.

G. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.

H. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

I. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

J. 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.

K. 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.

L. Insulate ends of spare conductors using vinyl insulating electrical tape.

M. 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.

N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

O. 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.

P. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.

Q. Route wire and cable as required to meet project conditions.

R. Use wiring methods indicated.

S. Pull all conductors into raceway at same time.

T. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

U. Neatly train and lace wiring inside boxes, equipment, and panelboards.

V. Clean conductor surfaces before installing lugs and connectors.
W. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
C. Perform field inspection and testing in accordance with Section 01 40 00.
D. Inspect and test in accordance with NETA ATS, except Section 4.
E. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
F. Correct deficiencies and replace damaged or defective conductors and cables.
G. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION
SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.
B. Conductors for grounding and bonding.
C. Connectors for grounding and bonding.
D. Ground rod electrodes.
E. Grounding and bonding components.
F. Provide all components necessary to complete the grounding system(s) consisting of:
   1. Metal underground water pipe.
   2. Metal frame of the building.
   3. Rod electrodes.

1.02 RELATED REQUIREMENTS

A. Section 09 69 00 - Access Flooring.
B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.
C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
D. Section 26 41 13 - Lightning Protection for Structures.
E. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.
F. Section 33 79 00 - Site Grounding.

1.03 REFERENCE STANDARDS

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
I. 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. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 09 69 00.
   4. Notify Architect of any conflicts with or deviations from the 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 PERFORMANCE REQUIREMENTS
A. Grounding System Resistance: 5 ohms.

1.06 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
B. Product Data: Provide for grounding electrodes and connections.
C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
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.
E. Project Record Documents: Record actual locations of components and grounding electrodes.
F. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.07 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS
2.01 GROUNDING AND BONDING REQUIREMENTS
A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
B. 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.
C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
D. 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.

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 05 26:
   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:
   b. Substitutions: See Section 01 60 00 - Product Requirements.

5. Manufacturers - Exothermic Welded Connections:
   b. Substitutions: See Section 01 60 00 - Product Requirements.

D. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.
   4. Manufacturers:
      b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MANUFACTURERS
   D. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ELECTRODES
   A. Rod Electrodes: Copper.
      1. Diameter: 3/4 inch (19 mm).
      2. Length: 8 feet (2400 mm).

2.05 CONNECTORS AND ACCESSORIES
   A. Mechanical Connectors: Bronze.
   B. Exothermic Connections:
   C. Wire: Stranded copper.
   D. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

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 shown on the drawings.
   C. Verify that conditions are satisfactory for installation prior to starting work.
   D. Verify existing conditions prior to beginning work.
   E. Verify that final backfill and compaction has been completed before driving rod electrodes.

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 (150 mm)
         below finished grade.
2. Indoor Installations: Unless otherwise indicated, install with 4 inches (100 mm) of top of rod exposed.

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 05 53.

F. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

G. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.

H. Provide bonding to meet requirements described in Quality Assurance.

3.03 FIELD QUALITY CONTROL
   A. See Section 01 40 00 - Quality Requirements, for additional requirements.
   B. Perform inspection in accordance with Section 01 40 00.
   C. Inspect and test in accordance with NETA ATS except Section 4.
   D. Perform inspections and tests listed in NETA ATS, Section 7.13.
   E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION
SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02  RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.
C. Section 26 05 34 - Conduit: Additional support and attachment requirements for conduits.
D. Section 26 05 37 - Boxes: Additional support and attachment requirements for boxes.
E. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
F. Section 26 51 13 - Luminaires, Ballasts, and Drivers - Lutron: Additional support and attachment requirements for luminaires.
G. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.
H. Conduit and equipment supports.
I. Anchors and fasteners.

1.03  REFERENCE STANDARDS

D. MFMA-4 - Metal Framing Standards Publication; 2004.
E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
F. 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. 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 the 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 30 00.

1.05  SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer’s catalog data for fastening systems.
C. 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 NFPA 70.

PART 2 PRODUCTS
2.01 SUPPORT AND ATTACHMENT COMPONENTS
   A. General Requirements:
      1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.

2.02 MANUFACTURERS
   C. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MATERIALS
   A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
   B. Supports: Fabricated of structural steel or formed steel members; galvanized.
   C. Anchors and Fasteners:
      1. Obtain permission from Architect before using powder-actuated anchors.
      2. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
      3. Concrete Surfaces: Use self-drilling anchors or expansion anchors.

PART 3 EXECUTION
3.01 INSTALLATION
   A. Install products in accordance with manufacturer’s instructions.
   B. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

END OF SECTION
SECTION 26 05 34 - CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Aluminum rigid metal conduit (RMC).
C. Intermediate metal conduit (IMC).
D. PVC-coated galvanized steel rigid metal conduit (RMC).
E. Flexible metal conduit (FMC).
F. Liquidtight flexible metal conduit (LFMC).
G. Electrical metallic tubing (EMT).
H. Rigid polyvinyl chloride (PVC) conduit.
I. Conduit fittings.
J. Accessories.
K. Conduit, fittings and conduit bodies.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.
B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.
D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
E. Section 26 05 35 - Surface Raceways.
F. Section 26 05 37 - Boxes.
G. Section 26 05 40 - Underfloor Ducts.
H. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
I. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
J. Section 27 10 05 - Structured Cabling for Voice and Data - Inside-Plant: Additional requirements for communications systems conduits.
K. Section 31 23 16 - Excavation.
M. Section 31 23 23 - Fill: Bedding and backfilling.
N. Section 33 71 19 - Electrical Underground Ducts and Manholes.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.
D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
N. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
P. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
Q. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
R. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
S. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
T. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, flexible nonmetallic conduit, nonmetallic tubing, fittings, and conduit bodies.
C. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches (51 mm).

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.
1.07 DELIVERY, STORAGE, AND HANDLING
   A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.
   B. Accept conduit on site. Inspect for damage.
   C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
   D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS
   A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
   B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

2.02 CONDUIT 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 a mandrel through them.
   B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
   C. Provide products listed, classified, and labeled as suitable for the purpose intended.
   D. 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. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
   B. Fittings:
      1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
      2. Material: Use steel or malleable iron.
      3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)
   A. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.
   B. Fittings:
      1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
      3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 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. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
      2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.06 METAL CONDUIT
A. Manufacturers:
   4. Substitutions: See Section 01 60 00 - Product Requirements.
B. Rigid Steel Conduit: ANSI C80.1.
C. Intermediate Metal Conduit (IMC): Rigid steel.
D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.07 FLEXIBLE METAL CONDUIT (FMC)
A. 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 to be used.
B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)
A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

2.09 ELECTRICAL METALLIC TUBING (EMT)
A. Manufacturers:
B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
C. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.
   3. Connectors and Couplings: Use compression (gland) or set-screw type.
      a. Do not use indenter type connectors and couplings.
D. Description: ANSI C80.3; galvanized tubing.
E. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron compression type.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT
A. Manufacturers:
   4. Substitutions: See Section 01 60 00 - Product Requirements.
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.

D. Description: NEMA TC 2; Schedule 40 PVC.

E. Fittings and Conduit Bodies: NEMA TC 3.

2.11 ACCESSORIES
   A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
   B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that field measurements are as shown on drawings.
   B. Verify that mounting surfaces are ready to receive conduits.
   C. Verify that conditions are satisfactory for installation prior to starting work.
   D. Verify routing and termination locations of conduit prior to rough-in.
   E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION
   A. Install products in accordance with manufacturer's instructions.
   B. Perform work in accordance with NECA 1 (general workmanship).
   C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
   D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
   E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
   F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
   G. Conduit Support:
      1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
      2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   H. 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. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

I. 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. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
   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. Include proposed locations of penetrations and methods for sealing with submittals.
   8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

J. 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 conduits are subject to earth movement by settlement or frost.

K. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
   1. Where conduits pass from outdoors into conditioned interior spaces.
   2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

L. Provide grounding and bonding in accordance with Section 26 05 26.

3.03 CLEANING
   A. Clean interior of conduits to remove moisture and foreign matter.

3.04 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.

3.05 INTERFACE WITH OTHER PRODUCTS
   A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

END OF SECTION
SECTION 26 05 37 - BOXES

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Wall and ceiling outlet boxes.
B. Floor boxes.
C. Pull and junction boxes.

1.02  RELATED REQUIREMENTS
A. Section 07 84 00 - Firestopping.
B. Section 26 27 16 - Electrical Cabinets and Enclosures.
C. Section 26 27 26 - Wiring Devices: Wall plates in finished areas.

1.03  REFERENCE STANDARDS
A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
C. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04  SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.05  QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.

PART 2  PRODUCTS

2.01  MANUFACTURERS
B. Arc-Co./Division of Arcade Technology:  www.arc-co.com.
D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02  OUTLET BOXES
A. Sheet Metal Outlet Boxes:  NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes:  Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.
B. Cast Boxes:  NEMA FB 1, Type FD, aluminum.  Provide gasketed cover by box manufacturer. Provide threaded hubs.
C. Wall Plates for Finished Areas:  As specified in Section 26 27 26.

2.03  FLOOR BOXES
A. Floor Boxes:  NEMA OS 1, fully adjustable, 1-1/2 inches (38 mm) deep.
B. Material:  Cast metal.

2.04  PULL AND JUNCTION BOXES
A. Sheet Metal Boxes:  NEMA OS 1, galvanized steel.
B. Hinged Enclosures:  As specified in Section 26 27 16.
C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
   1. Material: Galvanized cast iron.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
   1. Material: Galvanized cast iron.
   2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
   3. Cover Legend: "ELECTRIC".

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

3.02 INSTALLATION
A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
   1. Adjust box locations up to 10 feet (3 m) if required to accommodate intended purpose.

D. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
E. Maintain headroom and present neat mechanical appearance.
F. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
G. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
H. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
I. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
J. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
K. Use flush mounting outlet box in finished areas.
L. Use stamped steel bridges to fasten flush mounting outlet box between studs.
M. Use adjustable steel channel fasteners for hung ceiling outlet box.
N. Do not fasten boxes to ceiling support wires.
O. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches (305 mm) of box.
P. Use gang box where more than one device is mounted together. Do not use sectional box.
Q. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 ADJUSTING
A. Adjust flush-mounting outlets to make front flush with finished wall material.
B. Install knockout closures in unused box openings.

3.04 CLEANING
A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Warning signs and labels.

1.02  RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting.
B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.03  REFERENCE STANDARDS

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04  SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
B. Product Data: Provide catalog data for nameplates, labels, and markers.
C. 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. Conform to requirements of NFPA 70.

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.
   2. 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.

B. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
   2. 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.

2.02  MANUFACTURERS

2.03 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Materials:
   2. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

B. Identification Labels:
   1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
   2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

D. Locations:
   1. Each electrical distribution and control equipment enclosure.
   2. Communication cabinets.
   3. Lighting control system.

E. Letter Size:
   1. Use 1/4 inch (6 mm) letters for identifying grouped equipment and loads.

F. Labels: Embossed adhesive tape, with 3/16 inch (5 mm) white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations, and ______.

2.04 WIRE AND CABLE MARKERS

A. Manufacturers:
   1. Brady corporation______.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

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 (3 mm).

G. Color: Black text on white background unless otherwise indicated.

H. Description: Cloth type wire markers.

I. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.

2.05 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
   1. Materials:
   2. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.

C. 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.


3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Degrease and clean surfaces to receive nameplates and labels.

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:
   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. Interior Components: Legible from the point of access.
   6. 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.

END OF SECTION
SECTION 26 21 00 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Electrical service requirements.

1.02 RELATED REQUIREMENTS
A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
D. Section 26 24 13 - Switchboards: Service entrance equipment.
E. Section 26 24 16 - Panelboards: Service entrance equipment.
F. Section 26 28 18 - Enclosed Switches: Service entrance equipment.

1.03 REFERENCE STANDARDS
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
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. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
B. Coordination:
   1. Verify the following with Utility Company representative:
      a. Utility Company requirements, including division of responsibility.
      b. Exact location and details of utility point of connection.
      c. Utility easement requirements.
      d. Utility Company charges associated with providing service.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
   3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
D. Utility Company charges associated with providing permanent service to be paid by Owner.
E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
F. Scheduling:
   1. Where work of this section involves interruption of existing electrical service, arrange service interruption with owners and existing tenants
   2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Utility Company letter of availability for providing electrical service to project.
C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.
D. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.
   1. Obtain Utility company approval of shop drawings prior to submittal.

1.06 QUALITY ASSURANCE
A. Comply with the following:
   2. NFPA 70 (National Electrical Code).
   3. The requirements of the Utility Company.
   4. The requirements of the local authorities having jurisdiction.

PART 2 PRODUCTS
2.01 ELECTRICAL SERVICE REQUIREMENTS
A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
B. Electrical Service Characteristics: As indicated on drawings.
C. Utility Company: As indicated on drawings.
D. Division of Responsibility: As indicated on drawings.
E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that field measurements are as shown on drawings.
B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION
A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION
A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Arrange equipment to provide minimum clearances and required maintenance access.
D. Provide required trenching and backfilling in accordance with Section 31 23 16.13.
E. Provide required protective bollards in accordance with Utility Company requirements.
F. Provide required support and attachment components in accordance with Section 26 05 29.
G. Provide grounding and bonding for service entrance equipment in accordance with Section 26 05 26.
H. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 05 53.
3.04 PROTECTION
   A. Protect installed equipment from subsequent construction operations.

END OF SECTION
PART 1  GENERAL
PART 2  PRODUCTS
2.01 MANUFACTURERS
2.02 SWITCHBOARDS

A. Provide switchboards 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: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:
   1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
      a. Altitude: Less than 6,600 feet (2,000 m).
      b. Ambient Temperature:
   2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:

F. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

G. Bussing: Sized in accordance with UL 891 temperature rise requirements.
   1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
   2. Provide solidly bonded equipment ground bus through full length of switchboard, 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.
   1. Line Conductor Terminations:
      a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Main and Neutral Lug Type: Mechanical.
   2. Load Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Lug Type:

I. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Finish: Manufacturer's standard unless otherwise indicated.

J. Future Provisions:
   1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Instrument Transformers:
   2. Select suitable ratio, burden, and accuracy as required for connected devices.

2.03 OVERCURRENT PROTECTIVE DEVICES

END OF SECTION
SECTION 26 24 16 - PANELBOARDS

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 26 05 26 - Grounding and Bonding for Electrical Systems.
B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS
A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2009.
D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
E. NEMA PB 1 - Panelboards; 2011.
F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
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.
K. UL 67 - Panelboards; Current Edition, Including All Revisions.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. 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.
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. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
1.06 MAINTENANCE MATERIALS
   A. See Section 01 60 00 - Product Requirements, for additional provisions.
   B. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Square D see MEP schedule.
   B. Source Limitations: Furnish panelboards and associated components produced by the same
      manufacturer as the other electrical distribution equipment used for this project and obtained
      from a single supplier.

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 (2,000 m).
      2. Ambient Temperature:
         a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and
            104 degrees F (40 degrees C).
   C. Short Circuit Current Rating:
   D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
   E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
   F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
      1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for
         each feeder and branch circuit equipment grounding conductor.
   G. Conductor Terminations: Suitable for use with the conductors to be installed.
   H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
      1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the
         following installation locations:
      2. Boxes: Galvanized steel unless otherwise indicated.
         a. Provide wiring gutters sized to accommodate the conductors to be installed.
      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.
      4. Lockable Doors: All locks keyed alike unless otherwise indicated.
   I. Future Provisions: Prepare all unused spaces for future installation of devices including
      bussing, connectors, mounting hardware and all other required provisions.

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: Aluminum.
   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.

F. Description: NEMA PB 1, circuit breaker type.

G. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

H. Minimum integrated short circuit rating: As indicated.

I. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.

J. Circuit Breaker Accessories: Trip units and auxiliary switches as 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:

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.

F. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

G. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.

H. Minimum Integrated Short Circuit Rating: As indicated.

I. Enclosure: NEMA PB 1, Type 1.

J. Cabinet Box: 6 inches (153 mm) deep, 20 inches (508 mm) wide for 240 volt and less panelboards, 20 inches (508 mm) wide for 480 volt panelboards.

K. Cabinet Front: Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

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.

PART 3 EXECUTION

3.01 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 supports in accordance with Section 26 05 29.
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 (2000 mm) above the floor or working platform.
I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
J. Provide grounding and bonding in accordance with Section 26 05 26.
K. Install all field-installed branch devices, components, and accessories.
L. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.
M. Install panelboards plumb. Install recessed panelboards flush with wall finishes.
N. Provide filler plates to cover unused spaces in panelboards.
O. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
P. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
Q. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
   1. Minimum spare conduits: 5 empty 1 inch (DN27).
R. Ground and bond panelboard enclosure according to Section 26 05 26.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
C. Perform field inspection and testing in accordance with Section 01 40 00.
D. Inspect and test in accordance with NETA ATS, except Section 4.
E. 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.
F. Correct deficiencies and replace damaged or defective panelboards or associated components.
G. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION
PART 1 GENERAL

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Square D see MEP schedule where applicable.

2.02 POWER DISTRIBUTION UNITS
A. Power Distribution Unit: For data processing equipment, suitable for underfloor cable connection, providing surge protection, harmonic filters, isolation transformer, voltage regulation, and branch circuit overcurrent protective devices.

B. Service Conditions:
1. Temperature: 32 degrees F (0 degrees C) and 104 degrees F (40 degrees C).
2. Humidity: Less than 95 percent humidity (non-condensing).
3. Altitude: Less than 3,300 feet (1,000 meters) above sea level.

C. Ratings:

D. Isolation Transformer: NEMA ST 20, factory-assembled, air cooled dry type shielded isolation transformer, ratings to match unit ratings specified.

E. Branch Circuit Panelboard: NEMA PB 1, circuit breaker type, with bus ratings to match unit capacity specified. Provide copper ground bus and double capacity neutral bus.

F. Molded Case Circuit Breakers: Plug-in type thermal magnetic trip circuit breakers, with common trip handle for all poles; UL listed.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS
   A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   B. Section 26 05 34 - Conduit.
   C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
   D. Section 26 05 37 - Boxes.
   E. Section 26 27 26 - Wiring Devices.

1.03 REFERENCE STANDARDS
   A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
   B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
   C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
   C. 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. Conform to requirements of NFPA 70.
   B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.06 COORDINATION
   A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   B. Determine connection locations and requirements.
   C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
   D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.01 MATERIALS
   A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
      1. Colors: Conform to 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. Flexible Conduit: As specified in Section 26 05 34.
   C. Wire and Cable: As specified in Section 26 05 19.
   D. Boxes: As specified in Section 26 05 37.
2.02 EQUIPMENT CONNECTIONS
   A. Owners, and mechanical field verify all required connections:
      1. Electrical Connection: Flexible conduit.
      2. Electrical Connection: Cord and plug (NEMA 6-20R).
      3. Provide field-installed disconnect switch.
      4. Location: Field verify all required connections

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.

END OF SECTION
SECTION 26 27 26 - WIRING DEVICES

PART 1  GENERAL

1.01  SECTION INCLUDES
   A. Wall switches.
   B. Wall dimmers.
   C. Receptacles.
   D. Wall plates.
   E. Floor box service fittings.

1.02  RELATED REQUIREMENTS
   A. Section 26 05 37 - Boxes.
   B. Section 26 05 37 - Boxes.

1.03  REFERENCE STANDARDS
   B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
   C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
   D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
   E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
   F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
   G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

1.04  SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
   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.

1.05  QUALITY ASSURANCE
   A. Conform to 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.

PART 2  PRODUCTS

2.01  MANUFACTURERS
D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ALL WIRING DEVICES
A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
B. Finishes:

2.03 WALL SWITCHES
A. Wall Switches - 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.
B. Wall Switches: Heavy Duty, AC only general-use snap switch, complying with NEMA WD 6 and WD 1.
   1. Body and Handle: Ivory plastic with toggle handle.
   2. Ratings: Match branch circuit and load characteristics.
C. Switch Types: Single pole, double pole, and 3-way.

2.04 WALL DIMMERS
A. Wall Dimmers - General Requirements: 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, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

2.05 RECEPTACLES
A. Receptacles - 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.
B. Receptacles: Heavy duty, complying with NEMA WD 6 and WD 1.
   1. Device Body: Ivory plastic.
   2. Configuration: NEMA WD 6, type as specified and indicated.
C. Convenience Receptacles: Type 5 to 15.
D. Duplex Convenience Receptacles.
E. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
F. Hospital Use Receptacles.

2.06 TELEPHONE JACKS

2.07 WALL PLATES
A. 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.
B. Decorative Cover Plates: Ivory, smooth plastic.
C. Jumbo Cover Plates: Ivory, smooth plastic.
D. Weatherproof Cover Plates: Gasketed cast metal with hinged.

**2.08 FLOOR BOX SERVICE FITTINGS**

A. Description: Service fittings compatible with floor boxes provided under Section 26 05 37 with components, adapters, and trims required for complete installation.

B. Flush Cover Convenience Receptacles:
   1. Material: Aluminum.
   2. Configuration: Duplex flap opening.

C. Flush Cover Communication Outlets:
   1. Material: Aluminum.
   2. Configuration: 2-1/8 inch (54 mm) x 1 inch (25 mm) combination threaded opening.

D. Flush Cover Combination Fittings:
   1. Material: Aluminum.
   2. Configuration: Duplex flap opening with 2-1/8 inch (54 mm) x 1 inch (25 mm) combination threaded opening.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

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

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 branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. 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 05 37 as required for installation of wiring devices provided under this section.

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 (150 mm) 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. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.
K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

L. Do not share neutral conductor on branch circuits utilizing wall dimmers.

M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

N. 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.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P. Install receptacles with grounding pole on top.

Q. Connect wiring device grounding terminal to outlet box with bonding jumper.

R. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

S. Connect wiring devices by wrapping conductor around screw terminal.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 37 to obtain mounting heights specified.

B. Install dimmer 48 inches (1.2 m) above finished floor.

3.05 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.

C. Inspect each wiring device for damage and defects.

D. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

E. Operate each wall switch with circuit energized and verify proper operation.

F. Verify that each receptacle device is energized.

G. Test each receptacle to verify operation and proper polarity.

H. Correct wiring deficiencies and replace damaged or defective wiring devices.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Enclosed circuit breakers.

1.02 RELATED REQUIREMENTS
   A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
   C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS
   A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
   B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
   C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
   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.

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.05 QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70.
   B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   C. Schneider Electric; Square D Products; ______: www.schneider-electric.us.
   D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ENCLOSED CIRCUIT BREAKERS
   A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
   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 (2,000 m).
   2. Ambient Temperature: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

D. Short Circuit Current Rating:

E. Conductor Terminations: Suitable for use with the conductors to be installed.

F. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.

G. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

H. Provide externally operable handle with means for locking in the OFF position.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. 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.

B. Interrupting Capacity:
   1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
   2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

C. Conductor Terminations:
   1. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

D. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

2.04 TRIP UNITS

A. Field-Changeable Ampere Rating Circuit Breaker: Provide circuit breakers with frame sizes 200 amperes and larger with changeable trip units.

PART 3 EXECUTION

3.01 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 supports in accordance with Section 26 05 29.

E. Install enclosed circuit breakers plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 05 26.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.

C. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.
D. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than _____ amperes. Tests listed as optional are not required.

E. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

F. Perform field inspection and testing in accordance with Section 01 40 00.

G. Inspect and test each circuit breaker.

H. Inspect each circuit breaker visually.

I. Perform several mechanical ON-OFF operations on each circuit breaker.

J. Verify circuit continuity on each pole in closed position.

K. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements.

L. Include description of testing and results in test report.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer’s recommended torque settings.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Fusible switches.
   B. Nonfusible switches.

1.02 RELATED REQUIREMENTS
   A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

1.03 REFERENCE STANDARDS
   A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
   B. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2002.
   C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
   E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
   A. See Section 01 30 00 - 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.

1.05 QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   C. Schneider Electric; Square D Products; ______: www.schneider-electric.us.
   D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS
   A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
      1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
      2. Handle lockable in OFF position.
      3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
   B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
      1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
      2. Handle lockable in OFF position.
   C. Enclosures: NEMA KS 1.
      1. Interior Dry Locations: Type 1.
      2. Exterior Locations: Type 3R.
PART 3  EXECUTION

3.01  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 supports in accordance with Section 26 05 29.
   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
      (2000 mm) above the floor or working platform.
   G. Provide grounding and bonding in accordance with Section 26 05 26.
   H. Install fuses in fusible disconnect switches.
   I. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size
      installed.

3.02  FIELD QUALITY CONTROL
   A. See Section 01 40 00 - Quality Requirements, for additional requirements.
   B. Perform field inspection in accordance with Section 01 40 00.
   C. Inspect and test in accordance with NETA ATS, except Section 4.
   D. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
   E. Correct deficiencies and replace damaged or defective enclosed safety switches or associated
      components.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Interior luminaires.
B. Emergency lighting units.
C. Exit signs.
D. Ballasts and drivers.
E. Lamps.
F. Luminaire accessories.

1.02 RELATED REQUIREMENTS
A. Section 26 05 37 - Boxes.

1.03 REFERENCE STANDARDS
C. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type); 2002.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
J. UL 1598 - Luminaires; 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 the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
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.

D. 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.

E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

1.06 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Conform to requirements of NFPA 70 and NFPA 101.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 WARRANTY
A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS - LUMINAIRES
A. As indicated on fixture schedule.
B. Substitutions: See Section 01 60 00 - Product Requirements, except where individual luminaire types are designated with substitutions not permitted.

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.

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. 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.

2.04 LUMINAIRES
A. Furnish products as indicated in Schedule attached to this section.
B. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 EXIT SIGNS
A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
   1. Number of Faces: Single or double as indicated or as required for the installed location.
   2. Directional Arrows: As indicated or as required for the installed location.
B. Manufacturers:
   1. Substitutions: See Section 01 60 00 - Product Requirements.
C. Exit Signs: Exit sign fixture suitable for use as emergency lighting unit.
   1. Face:
   2. Directional Arrows: Universal type for field adjustment.
   3. Mounting: As indicated.

2.06 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.

2.07 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.
B. Lamp Types: As specified for each luminaire.

2.08 ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that field measurements are as shown on the drawings.
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 INSTALLATION
A. Coordinate locations of outlet boxes provided under Section 26 05 37 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. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
F. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).

G. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

H. Support luminaires larger than 2 x 4 foot (600 x 1200 mm) size independent of ceiling framing.

I. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

J. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

K. Install recessed luminaires to permit removal from below.

L. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Drawings.

M. Install accessories furnished with each luminaire.

N. Connect luminaires and exit signs to branch circuit outlets provided under Section 26 05 37 using flexible conduit.

O. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

P. Bond products and metal accessories to branch circuit equipment grounding conductor.

Q. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.

R. 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.

S. 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.

T. Install lamps in each luminaire.

### 3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Perform field inspection in accordance with Section 01 40 00.

D. Operate each luminaire after installation and connection to verify proper operation.

E. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

F. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

### 3.04 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.

D. Aim and adjust luminaires as indicated.

E. Position exit sign directional arrows as indicated.
3.05 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.
   B. Clean electrical parts to remove conductive and deleterious materials.
   C. Remove dirt and debris from enclosures.
   D. Clean finishes and touch up damage.

3.06 CLOSEOUT ACTIVITIES

3.07 PROTECTION
   A. Relamp luminaires that have failed lamps at Substantial Completion.

3.08 SCHEDULE - ATTACHED

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES
A. Exterior luminaires.
B. Ballasts.
C. Lamps.
D. Poles and accessories.

1.02  RELATED REQUIREMENTS
A. Section 26 05 37 - Boxes.

1.03  REFERENCE STANDARDS
C. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type); 2002.
E. IES RP-8 - Roadway Lighting; 2014.
F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
I. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.04  ADMINISTRATIVE REQUIREMENTS
A. Coordination: Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.05  SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
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.
D. Test Reports: Indicate measured illumination levels.
E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
G. Maintenance Materials: Furnish the following for []ners use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
1.06 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

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.
C. Receive, handle, and store wood poles in accordance with ANSI O5.1.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. See fixture schedule.
B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LUMINAIRE TYPES
A. Furnish products as indicated in luminaire schedule included on the drawings.

2.03 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.

2.04 BALLASTS
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. Fluorescent Ballasts: ANSI C82.1, high power factor type electromagnetic ballast, suitable for lamps specified.
C. High Intensity Discharge (HID) Ballasts: ANSI C82.4, mercury vapor lamp ballast, suitable for lamp specified.

2.05 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.

2.06 POLES

A. All Poles:
   1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 05 37 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. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
F. Install accessories furnished with each luminaire.
G. Bond products and metal accessories to branch circuit equipment grounding conductor.
H. Install poles plumb.
   1. Provide shims to adjust plumb.
   2. Grout around each base.
I. Install lamps in each luminaire.
J. Bond luminaires, metal accessories, and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Inspect each product for damage and defects.
C. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.
D. Operate each luminaire after installation and connection to verify proper operation.
E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.
F. Measure illumination levels to verify conformance with performance requirements. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.03 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 adjust luminaires to provide illumination levels and distribution indicated on Drawings.

3.04 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.
B. Clean electrical parts to remove conductive and deleterious materials.
C. Remove dirt and debris from enclosure.
D. Clean photometric control surfaces as recommended by manufacturer.
E. Clean finishes and touch up damage.
3.05 CLOSEOUT ACTIVITIES
3.06 SCHEDULE - SEE DRAWINGS

END OF SECTION
SECTION 27 51 32 - TELEVISION SYSTEMS

PART 1  GENERAL
1.01  SECTION INCLUDES
   A. Television service entrance.
   B. Television distribution equipment.
   C. Cable and accessories.

1.02  RELATED REQUIREMENTS
   A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   B. Section 26 05 34 - Conduit.
   C. Section 26 05 37 - Boxes.

1.03  REFERENCE STANDARDS
   A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04  SYSTEM DESCRIPTION
   A. Service entrance from local cable utility.
   B. Premises wiring for broadband distribution of television signal, including individual outlets.
   C. Signal at each outlet: 3 dBmV across 75 ohms, minimum, plus 5 dB, minus 0 dB.

1.05  SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show installation details, cable routing, and system configuration.
   C. Product Data: Provide showing electrical characteristics and connection requirements for each component.

1.06  QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70 and cable television utility company.

1.07  MAINTENANCE SERVICE
   A. Furnish service and maintenance of television system for one year from Date of Substantial Completion.

PART 2  PRODUCTS

PART 3  EXECUTION
3.01  INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Connect cable television service in accordance with cable utility instructions.
   C. Provide proper grounding of television system components and wiring. Bond outdoor components to lightning protection system.

3.02  FIELD QUALITY CONTROL
   A. See Section 01 40 00 - Quality Requirements, for additional requirements.
   B. Perform field inspection and testing in accordance with Section 01 40 00.
   C. Measure signal level at each outlet.

3.03  MANUFACTURER’S FIELD SERVICES
   A. Provide services of manufacturer's technical representative to prepare and start systems and supervise final adjustments and tuning of system.
3.04 ADJUSTING
   A. Adjust work under supervision of manufacturer's field service personnel.

3.05 DEMONSTRATION
   A. Conduct walking tour of Project and briefly describe function, operation, and maintenance of each component.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fire alarm system design and installation, including all components, wiring, and conduit.
B. Transmitters for communication with supervising station.
C. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.

1.02 REFERENCE STANDARDS
B. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Evidence of designer qualifications.
C. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
  10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
  11. Certification by the manufacturer of the control unit that the system design complies with the contract documents.
  12. Certification by Contractor that the system design complies with the contract documents.
  13. Do not show existing components to be removed.
D. Evidence of installer qualifications.
E. 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 Form," filled out.
F. Operating and Maintenance Data: See Section 01 78 00 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 authority having jurisdiction.
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 to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

G. Project Record Documents: See Section 01 78 00 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, updated input/output chart, and voice messages by event.

H. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with his 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 authority having jurisdiction.

1.04 QUALITY ASSURANCE
A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Fire Alarm Control Units - Basis of Design: SELECT/ENTER MANUFACTURER NAME AND ENTER MODEL NUMBER.

2.02 FIRE ALARM SYSTEM
A. Fire Alarm System: modifications and extensions to the existing automatic fire detection and alarm system: The existing system as installed by Universal Time Equipment Company. Contact Chris Gray 903-595-4441
1. Provide all components necessary, regardless of whether shown in the contract documents or not.
2. Protected Premises: Entire building shown on drawings.
3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
   a. ADA Standards.
b. The requirements of the local authority having jurisdiction, which is _______.
c. Applicable local codes.
d. The contract documents (drawings and specifications).
e. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.

4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
7. Program notification zones and voice messages as directed by owner.
8. Fire Command Center: Location indicated on drawings.

B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By on-premises supervising station.
2. On-Premises Supervising Station: proprietary station operated by owner
3. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.

C. Circuits:
1. Initiating Device Circuits (IDC): Class B, Style A.
2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
3. Notification Appliance Circuits (NAC): Class B, Style W.

D. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.

2.03 EXISTING COMPONENTS
A. On-Premises Supervising Station: Include as part of this work all modifications necessary to existing supervising station to accommodate new fire alarm work.
B. Clearly label components that are "Not In Service."
C. Remove unused existing components and materials from site and dispose of properly.

2.04 FIRE SAFETY SYSTEMS INTERFACES
A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:

2.05 COMPONENTS
A. General:
1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
B. Fire Alarm Control Units, Initiating Devices, and Notification Appliances: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.
C. Master Control Unit: As specified for Basis of Design above, or equivalent.
D. Initiating Devices:
E. Notification Appliances:
F. Circuit Conductors: Copper or optical fiber; provide 200 feet (60 m) extra; color code and label.

G. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

H. Locks and Keys: Deliver keys to [owner].

I. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator’s station.
1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
2. Provide one for each control unit where operations are to be performed.
3. Obtain approval of [owner] prior to mounting; mount in location acceptable to [owner].
4. Provide extra copy with operation and maintenance data submittal.

END OF SECTION