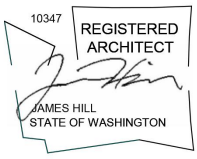
Jail - COVID Isolation Cells

Lewis County

Project No. J2037A

Project Manual – Bid Documents

August 7, 2020



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END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

B. Remove existing work as indicated and as required to accomplish new work.

C. Carefully remove, disassemble or dismantle and store on the site those items to be removed and re-used in the completed work or retained by Owner, all as indicated on the Drawings and/or specified.

1.02 SUBMITTALS

A. Submit to Owner demolition plan addressing the following, as applicable:
   1. Location of dust barriers for work in each construction area, including details.
   2. Proposed method of preventing dust/dirt/debris from entering into Owner occupied areas (control plan).
   3. Demolition disposal route to dumpsters, including debris chute if used, and cleanup plan.
   4. Description of method(s) for protecting existing and installed work.
   5. Schedule of required utility and building system shutdowns, if any.
   6. Schedule of demolition work in Owner occupied areas.
   7. Identify demolition work (saw cutting, drilling, removal) that will involve or affect any structural element or part of the building structure.

B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.03 FIELD CONDITIONS

A. Work to be Removed by Owner: Prior to starting selective building demolition work for this Project, Owner will remove certain furniture and plug-in equipment items as necessary for Contractor's progress of the Work.

B. Condition Of Building Prior To Selective Demolition: Accept premises on as "as-is" condition. Owner assumes no responsibility for building condition now, at time of bidding nor thereafter. Damage or loss resulting from any cause to building, persons and/or property shall not relieve contractor from his obligation to complete all work under the Contract.

C. Protection
   1. Before beginning selective demolition activities, erect barriers, fences, overhead protection, shoring, and the like, to protect personnel and construction.
   2. Keep free of damage those portions of existing building which are to remain. Contractor shall provide total protection for all existing portions of building against damage caused by construction means and any or all weather elements.
   3. Use wheeling equipment or buggies with air-filled tires over floors or in areas to remain.
   4. Any damage occurred shall be immediately corrected by the Contractor as directed by the Architect or Owner, at Contractor's expense.
   5. Cooperate with Owner for maintaining their continuous operations in all remaining portions of the existing facility during the work of this Project.
   6. Remove temporary protection and cover when no longer needed.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 INSPECTION

A. Hollow Core Concrete Slab Examination: Prior to cutting new opening in second floor precast hollow core floor plank Contractor shall perform imaging of slab to locate existing prestressed tendons to determine exact location of opening to minimize the number of tendons cut when sawcutting opening.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Provide, erect, and maintain temporary barriers and security devices.
   3. Use physical barriers to prevent access to areas that could be hazardous to workers, occupants or the public.
   4. Conduct operations to minimize obstruction of entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.

B. Do not begin removal until built elements to be salvaged or relocated have been removed.

C. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Dismantle existing construction and separate materials.
   2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.03 EXISTING UTILITIES

A. Protect existing utilities to remain from damage.

B. Do not disrupt public utilities without permit from authority having jurisdiction.

C. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 5 days prior written notification to Owner.

D. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Separate areas in which demolition is being conducted from other areas that are still occupied.

B. Selective Building Demolition - General
   1. Do all demolition, drilling and/or removal work, as applicable, required for the completion of new work shown on Drawings or specified. Refer to Drawings and details for specific items of construction to be removed and other demolition requirements for the new work.
   2. The extent of demolition required for the entire project shall be verified by the Contractor at the jobsite and performed to the fullest extent required due to actual job conditions and requirements of new work indicated.
   3. Where demolition occurs next to existing work to remain, remove carefully only those items required for placing new work. Conduct demolition to minimize interference with adjacent structures to remain.

4. Remove all loose material caused by or remaining from demolition work. Cut openings and/or pockets neatly ready for installation of new work. Use carborundum saws or approved means or devices where cuts will remain exposed in the completed work.
5. Coordinate demolition work with work in other Sections.

C. Materials & Equipment To Be Removed For Re-Use Or Turned Over To Owner
1. Carefully remove, disassemble or dismantle and store on the site those items to be removed and re-used in the completed work or retained by Owner, all as indicated on the Drawings and/or specified.
2. If wall mounted equipment items are encountered in areas where demolition of associated wall is required for new work, they shall be salvaged for reuse/reinstallation or, if not reused, shall be turned over to Owner.
3. All other debris and non-selected removed materials and equipment shall become the property of the Contractor and removed from site.

3.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Conditions of the Contract for Construction and the General Requirements of Division 1 of these Specifications apply to the Work in this Section.

1.2 SECTION INCLUDES

A. The Work of this Section shall include furnishing all labor, materials, equipment, and supervision to prepare the surface of the structural concrete members and to install the FRP Reinforcement as indicated on the Drawings.

1.3 REFERENCE STANDARDS

A. Comply with the following reference standards, except where more stringent requirements are indicated on the Drawings or specified herein:

1. American Concrete Institute (ACI)

    a. ACI 440.2R-08, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures
    b. ACI 440R-07, Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures
    c. ACI 440 R-96, State-of-the-Art Report on Fiber Reinforced Plastic (FRP) Reinforcement for Concrete Structures.
    d. ACI 503 R, Pull-off test to determine FRP adhesion to concrete substrate.

2. International Concrete Repair Institute (ICRI)

    a. ICRI Guideline No. 03742, Guide for the Selection of Strengthening Systems for Concrete Structures
    b. ICRI Guideline No. 03739, Guide to Using In-Situ Tensile Pull-Off Tests to Evaluate Bond of Concrete Surface Materials

3. American Society of Testing and Materials (ASTM) as cited herein.

1.4 QUALITY CONTROL

A. Quality Control procedures performed by the Manufacturer shall include, but not be limited to the following:

1. Manufacturer shall have a nationally recognized program of contractor training, certification and technical support.

2. The Manufacturer shall have minimum ten years experience in FRP Reinforcement confirmed by actual field tests of minimum 50 successful installations.

3. The Manufacturer shall be able to supply testing data to demonstrate system properties and durability of the actual FRP Reinforcement to be used.

B. Quality Control procedures performed by the Contractor shall include, but not be limited to the following:

1. The Contractor shall be trained by the Manufacturer and shall have completed a program of instruction in the use of FRP Reinforcement.

2. The Contractor shall have a minimum of two years experience in FRP Reinforcement confirmed by actual field tests of at least 5 successful installations.

3. The Contractor shall inspect all materials prior to application to assure that they meet specifications and have arrived to the job-site undamaged.

4. The FRP Reinforcement shall be completely inspected by the contractor during and immediately following application of the composite materials. Conformance with the design drawings, proper alignment of fibers and quality workmanship shall be assured. Entrapped air shall be released or rolled out before the epoxy sets. Defects shall be noted in the Daily Construction Log.

5. After FRP Reinforcement has cured, the contractor shall inspect the all work to check for voids and or debonding. Repairs shall be made as per Par. 3.7 Repair of Defects, and noted in the Daily Construction Log.

1.5 SUBMITTALS

A. Submit for record Material Safety Data Sheets (MSDS) of each product, used on site.

B. Submit product data indicating product standards, physical and chemical characteristics, environmental durability, technical specifications, limitations, installation instructions, and general recommendations regarding each material.

C. Submit for record, a qualification statement by the Contractor listing their completed FRP Reinforcement projects, including size, location, owner, engineer/architect and contact numbers.

D. Submit for record a complete description of the FRP Reinforcing system materials, surface preparation, application procedures, application rates, and cure times.

E. Submit for record copies of purchase order and packaging slips showing quantities and dates of primer and resin purchased.

F. Submit for review and approval shop drawings including, the following:

1. Limits of FRP Reinforcing.
2. Details of epoxy injection crack repair and epoxy resin patching.
3. Complete system details including, but not limited to, FRP Reinforcement, primer, resin, and protective coating.

G. Submit for record test results of the Pull-off test to determine FRP adhesion to concrete substrate.

H. Submit for record Daily Construction Logs kept by the Contractor. These logs shall include the following information: Weather and temperature at application times; Amount of product used and square footage/linear footage of substrate covered; Batch numbers of all products used; Names of all crew members; Any bond-strength tests, noting location, quantity and who performed these tests.

I. Submit an approved ICC Evaluation Report in the name of the proposed FRP system to be used on this project.

J. Submit structural calculations, signed and sealed by a Structural Engineer licensed in the State of Washington, for design of the FRP strengthening system.

K. Submit independent test report verifying the environmental durability of the proposed system to be used on this project. Such reports shall include as a minimum:

1. 10,000 hr. resistance to high temperature (38C) and high humidity (100%)
2. 10,000 hr. resistance to alkali solution (pH 9.5)
3. 3,000 hr. resistance to dry heat (60C)
4. resistance to 20 freeze/thaw cycles
5. resistance to UV/condensation @ 100 cycles

1.6 JOB-SITE CONDITIONS

A. The ambient temperature and temperature of the epoxy components shall be between 50□ F (10□C) and 80□ F (27□C) at the time of mixing. See appropriate technical data sheets for more specific instructions.

B. Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified material.

C. The Contractor is solely responsible for fume control and shall take necessary precautions against injury to Installer personnel or adjacent building occupants during application of primer and resin, etc. Contractor personnel shall use protective equipment and area shall be well vented to the outside. As a minimum, Installer must take the following precautions:

1. Contractor to locate and protect building air intake during application.
2. Contractor to follow all state, federal, and local safety regulations.
3. Contractor to follow all Manufacturers' safety requirements as indicated on appropriate MSDS sheets.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver primer, saturant and protective coating in original, unopened containers with the Manufacturer's name, labels, product identification, and batch numbers.

B. FRP Reinforcement shall be stored in a cool dry area away from direct sunlight, flame, moisture, or other hazards.

C. Store primer, saturant and protective coating under conditions as recommended by the Manufacturer in a cool dry place out of direct sunlight. Products that have exceeded their shelf life shall not be used.

D. Contractor is required to confirm that all materials used in accordance with this Section conform to local, state, and federal environmental and worker's safety laws and regulations.

E. During operations Contractor shall maintain barricades.

F. The Contractor shall properly dispose of empty containers in accordance with local regulations.

PART 2 - PRODUCTS

2.1 FRP REINFORCEMENT FABRIC AND/OR LAMINATE

A. FRP Reinforcement fabric shall be high strength, high modulus, fiber fabric that may be unidirectional or woven (in various fiber architectures) to suit specific repair needs.

1. FRP Reinforcement fabric shall be of the type, size, layer and location as indicated on the Drawings.
2. FRP Reinforcement fabric shall meet the following minimum requirements:

Property Prior to testing, laminate samples shall be cured at least 7 days at 70□F then post-cured at 140□F for 48 hours	**Requirement**	**ASTM Test Method**
Laminate Tensile Strength, In primary fiber direction – 1 layer, per inch width	3,000 lbs./layer (13.3 kN/layer)	D3039
Laminate Tensile Modulus, In primary fiber direction	$3.4x10^6$ psi (23,400 MPa)	D3039
Laminate Elongation at break	2.00%	D3039
Dry Fabric Weight, Minimum, per square yard	27 oz./yd^2 (913 g/m^2)	
Percent Laminate Tensile Strength Retained after: 7 days, 100% humidity,100□F (38□C) 3,000 hrs exposure to alkali 3,000 hrs exposure to salt water 3,000 hrs exposure at 140□F (60□C)	 90% 90% 90% 90%	
Visual Defects	□	D2563

2.2 CONCRETE SURFACE PRIMER

A. Surface Primer shall be a two component, 100% solids, moisture/tolerant, high modulus, high strength epoxy.

B. Surface Primer shall meet the following minimum requirements:

Property	Requirement	ASTM Test Method
Tensile Strength	8,000 psi	D638
Tensile Modulus	250,000 psi	D638

Elongation at Break	3.0%	D638
Flexural Strength	11,500 psi	D790
Flexural Modulus	500,000 psi	D790
Heat Deflection Temp. (HDT)	117F (47C)	D648

C. Approved products are:

2.3 FABRIC SATURANT

A. Saturant resin shall be two component, 100% solids, moisture tolerant, high strength, high modulus epoxy.

B. Saturants shall meet the following minimum requirements:

Property	Requirement	ASTM Test Method
Tensile Strength	8,000 psi	D638
Tensile Modulus	250,000 psi	D638
Elongation at Break	3.0%	D638
Flexural Strength	11,500 psi	D790
Flexural Modulus	500,000 psi	D790
Heat Deflection Temp. (HDT)	120 F	D648

1. Alternate products must be submitted **and** approved by the Engineer a minimum of two weeks prior to the bid date.

2.4 EPOXY REPAIR MORTAR

A. Repair mortar shall be 100% solids, non-sag paste epoxy.

2.5 PROTECTIVE COATING

A. Protective coating shall be polymer or acrylic based and shall be UV resistant.

PART 3 - EXECUTION

3.1 GENERAL

A. Inspect surfaces to receive the work and report immediately in writing to the Engineer as required in the General Conditions and deficiencies in the surface that render if unsuitable for proper execution of this work.

B. Protect vehicles, concrete, and other items surrounding work area from dust or damage due to Work of this Section.

3.2 SURFACE PREPARATION

A. All concrete surfaces shall be dry and free of surface moisture and frost, and tested by the Contractor to evaluate moisture transmission in accordance with ASTM D4263 “Indicating Moisture in Concrete by the Plastic Sheet Method.“

B. All concrete surfaces shall be sound. Remove deteriorated concrete, dust, laitance, grease, paint, curing compounds, waxes, impregnations, foreign particles, and other bond inhibiting materials from the surface by blast cleaning or equivalent mechanical means.

C. All concrete surfaces shall be air blasted and vacuumed clean to a dust free condition.

D. Concrete surface irregularities less than one inch shall be ground and smoothed and/or filled with an approved repair mortar with the addition of 1 part oven dried sand to make an epoxy mortar. Surface irregularities shall be limited to less than 0.04 inches (1 mm). Surface irregularities greater than one inch shall be repaired using an approved cementitious repair mortar.

E. External concrete corners shall be rounded to at least a 1/2" radius when perpendicular to fiber orientation and internal corners shall be smoothed by trowelling epoxy mortar into the corners.

F. The adhesive strength of the concrete shall be verified after preparation by random pull-off testing (ACI 503R) at the direction of the Engineer. Minimum tensile strength is 200 psi with concrete substrate failure, or as approved by the Engineer.

3.3 MIXING PRIMER AND SATURANT

A. Mix components in accordance with Manufacturer's recommendations.

B. Diluting is not permitted. Pre-condition materials as indicated on technical data sheet.

C. Mix only that quantity which can be used within its pot life.

D. Do not batch delivered units into smaller quantities. Mix only full units.

3.4 PRIMER APPLICATION

A. Apply primer in accordance with Manufacturer's recommendations.

B. Primer may be applied with a brush or roller. Apply second coat as necessary after first coat has penetrated into concrete.

C. Surface depressions shall be filled with epoxy filler per manufacturers' instructions.

D. Primer must be covered with fiber within 24 hours of application, depending on temperature conditions. If 24-hour window is exceeded, the primed surfaces must be solvent wiped with a fast flashing solvent or roughened with sandpaper to break the amine blush.

3.5 FRP Reinforcement

Application METHOD 1:

WET LAY-UP

A. Apply FRP Reinforcement in accordance with Manufacturer's recommendations.

B. When using saturator equipment, follow Manufacturer's procedures for proper machine set-up and calibration. Rollers shall be calibrated to saturate the fabric with the proper resin-to-fabric ratio. The roller gap shall be checked daily by a qualified technician for accuracy. The resin-to-fabric ratio shall also be verified by resin usage and documented on the daily project logs.

C. Once the fabric is saturated, it may then either be spooled for easy handling, or cut to specified lengths and booked for handling. Care must be taken not to damage the fibers.

D. The fabric may then be applied to the surface with no delay. Work from one end to the other, taking care to orient the fibers as specified. Remove any air entrapped in the fabric with a ribbed roller or squeegee.

E. Sheets shall be lapped in the longitudinal direction 6 inches minimum or as indicated on the Drawings. Note: no lapping is required of the sheets parallel to the direction of fiber orientation.

METHOD 2: DRY LAY-UP

A. Apply FRP Reinforcement in accordance with Manufacturer's recommendations.

B. FRP Reinforcement sheets shall be cut beforehand into prescribed lengths. Sheets shall be lapped in the longitudinal direction 6 inches minimum or as indicated on the Drawings. Note: no lapping is required of the sheets parallel to the direction of fiber orientation.

C. Follow Manufacturer's recommendations regarding primer open times.

D. Apply a primary saturant coat uniformly by roller brush.

E. Apply FRP Reinforcement sheets fiber side down to the concrete over the fresh saturant using a ribbed roller to remove any air bubbles.

E. FRP Reinforcement sheets shall be left alone for about 30 minutes allowing for the primary saturant to soak through the fabric. Correct any dislocation on lifting.

G. Apply secondary saturant coat with roller over installed sheets in order to impregnate and replenish primary saturant.

H. If succeeding FRP Reinforcement sheets are specified on the Drawings repeat application procedures.

3.6 CURING

A. Protect finished installation of FRP Reinforcement from rain, sand, dust, etc. using protective sheeting or other barriers. Do not allow protective sheeting to come in contact with finished application.

B. Curing of finished application shall be a minimum of 24 hours and in order to achieve full strength curing shall be extended for a period of two weeks at an average ambient temperature of 68□F.

3.7 REPAIR OF DEFECTS

A. Upon completion of the curing process, the installed system shall be checked for areas where saturant has not penetrated or where saturant has not completely cured. Such areas shall be epoxy injected to re-establish bond subject to the approval of the Project Engineer.

B. Repair procedures shall be performed in accordance with guidelines established by ACI 440.2R-08 (paragraph 7.2.3) and approved by the Project Engineer. All repairs shall be subject to the same application, curing and quality control specifications as the original work.

1. Small delaminations and voids less than 2 in^2 each are permissible as long as the delaminated area is less than 5% of the total laminate area and there are no more than 10 such delaminations per 10 ft^2.
2. Medium sized delaminations and voids greater than 2 in^2 but less than 25 in^2 may be repaired by epoxy resin injection or ply replacement, depending on the size and number of delaminations and their location. The repair procedure should be determined by the Project Engineer.
3. Larger size delaminations and voids greater than 25 in^2 should be repaired by selectively cutting away the affected sheet and applying an overlapping sheet patch of equivalent plies. The overlap should extend a minimum of 6 in. in all directions.

3.8 PROTECTIVE COATING

A. Apply protective coating in accordance with Manufacturer’s recommendations.

3.9 CLEANING

A. Uncured saturants may be cleaned from tools with an approved solvent and properly disposed.

B. Cured saturants shall be removed by mechanical means and properly disposed.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete slab infills where portions of existing slabs are removed for new utility work.

B. Cast-in-place concrete bench units.

C. Gravel capillary break base material and vapor barrier under new infill slabs on grade.

D. Formwork.

E. Concrete curing and finishing.

1.02 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry. Unit masonry for new bench units including re-bar reinforcing extending from masonry grouted cells.

B. New in-ground plumbing work covered under applicable Sections of Division 22.

1.03 REFERENCE STANDARDS

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).

B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (Errata 2007).

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.

E. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2008.

F. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2012.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2012.

H. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2010a.

I. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2012.

1.04 SUBMITTALS

A. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

B. Concrete Mix Data: Submit to Owner the following submittals in accordance with ACI-301:
   1. Admixture certification. Chloride ion content must be included.
   2. Concrete mix design. Submit a mix design for each strength and type of concrete. Clearly indicate where each mix design will be used.
   3. Materials and methods for curing.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

PART 2 - PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
   2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.

C. Chamfer Strips For Exposed Edge At New Benches: Wood or PVC strips, 3/4 x 3/4 inch size of maximum possible lengths.

2.02 REINFORCEMENT

A. Reinforcing Steel for Slab Infills: Furnish deformed bars conforming to ASTM Standard A615, Grade 60 (except #3 stirrups may be Grade 40). Bars shall be unpainted, uncoated, and free from rust, dirt and loose scale. Sizes as shown on Structural Drawings.

B. Reinforcement Accessories:
   1. Tie Wire: 16 gauge or heavier, double annealed wire.
   2. Spacer Bars for Wall Reinforcing: 3-inch bars, "U" shaped. Stock items of equivalent function may be submitted for approval.
   3. Mortar Blocks:
      a. Furnish as required for use as spacers in placing reinforcement; shall be two (2) inches square (maximum).
      b. Mortar blocks shall be constructed of mortar mixed with the same proportions of sand and cement used in concrete, and develop a minimum compressive strength of 4,000 psi at 28 days.
      c. Mortar blocks shall have a tie wire embedded and the protruding ends to be tied to the reinforcing steel to hold the mortar blocks in place; mortar blocks with a grooved top may be used for supporting steel in slabs.

2.03 CONCRETE MATERIALS

A. Portland Cement: Furnish conforming to ASTM C150, Type I or Type II. Use same brand of cement for all exposed work.

B. Fine Aggregate: Except as otherwise specified, furnish sand conforming to ASTM C33 with deleterious substances not to exceed those in Table I less subnote "a" thereof.

C. Coarse Aggregate
   1. Except as otherwise specified, furnish conforming to ASTM C33, maximum size 1/5 of narrowest dimension between forms of concrete member, 3/4 inch minimum clear spacing between reinforcing bars, with standard placing procedures in no case exceeding 1-1/2 inch size.
   2. If concrete pumping is employed, use 3/4 inch maximum size aggregate.

D. Fly Ash: Upon approval of Structural Engineer, furnish conforming to ASTM C618, Class F, with loss on ignition (LOI) maximum one percent (1%).

E. Water: Clean and not detrimental to concrete.

2.04 CHEMICAL ADMIXTURES

A. General
   1. Obtain approval for calcium compound use in all concrete; use no calcium compound in reinforced concrete.
   2. All admixtures shall be compatible with one another.

B. Air Entraining Agent: Furnish as manufactured by Dewey & Almy, Master Builders, Sika or Sonneborn, conforming to ASTM C260.

C. Water-Reducing Admixture: Furnish meeting requirements of ASTM C494, Type A, containing no set-accelerating or set-retarding compounds, chlorides, fluorides or nitrates; The Euclid Chemical Co. “Eucon WR-75”, Master Builders “Pozzolith 200N” or Sika Chemical Co. “Plastocrete 160”, or approved.

D. Moisture Vapor Reduction Admixture (MVRA) for Concrete For New Interior Building Slab Infills: Liquid, inorganic admixture free of volatile organic compounds (VOCs) and formulated to close capillary systems formed during curing to reduce moisture vapor emission and transmission, with no adverse effect on concrete properties.
   1. Products:
      a. Barrier One, Inc; Barrier One High Performance Admixture: www.barrierone.com.
      b. Hycrete, Inc; V1000: www.hycrete.com.
      c. ISE Logik Ind.: MVRA 900: www.iselogik.com.

2.05 ACCESSORY MATERIALS

A. Structural Backfill Material
   1. Backfill: In general, use previously excavated earth for compacted backfills.
   2. Should additional fill material be required, furnish imported select fill material consisting of clean, 3-inch minus, well graded gravel or gravely sand (classifying as GW or SW as determined by ASTM D2487), free of debris and organic material, conforming to APWA Specification 9-03.14 for Gravel Borrow with no more than 7% by weight fine material passing the No. 200 screen as tested by ASTM D1140.

B. Gravel Capillary Break Base Material Under New Interior Building Slab: Furnish clean sand and gravel containing at least 40 percent (by weight) gravel sized particles larger than a U.S. No. 4 sieve with fines limited to 5 percent or less.

C. Vapor Barrier Under New Interior Slabs On Grade Including Infills: Furnish Fortifiber Corp. "Moistop Ultra C" or Stego Industries “Stego Wrap” or W.R. Meadows “Vapor-Mat” 10 mil polyolefin vapor barrier sheeting meeting or exceeding performance requirements of ASTM E1745 Class B, or approved; polyethylene sheeting not permitted as a substitution. Furnish complete with manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder. Single ply polyethylene is prohibited.

2.06 BONDING AND JOINTING PRODUCTS

A. Bonding Agent: Furnish two (2) component, 100% solids, 100% reactive epoxy adhesive compound suitable for use on dry or damp surfaces; Larsen Products Corp. “Weld Crete” or The Eucid Chemical Co. “Euco Epoxy” #452MV or #620 or Sika Chemical Co. “Sikadur Hi-Mod”, or approved.

2.07 CURING MATERIALS

A. Curing Compound For Curing Exterior Slabs
   1. Compound shall be "Super Rez Seal" by The Euclid Chemical Co., "Vulkem 2101" by Mameco International, Inc., "Masterkure 30" by Master Builders, or "Sealtight CS-309" by W.R. Meadows.
   2. Manufacturer's certification required. (Sodium Silicate Compounds are prohibited.)

B. Protection Cover For Curing Interior Slab To Receive Floor Coverings: Furnish McTech Group "Ultracure Max" moisture retaining cover or reinforced waterproof kraft paper conforming to ASTM C171, Type I; liquid membrane-forming curing compound shall not be used for curing interior slab.

2.08 CONCRETE MIX DESIGN

A. Mix Designs
   1. Proportioning of ingredients for each concrete mix shall be in accordance with ACI-301, Paragraph 4.2.3, Proportioning, using field test data where available and meeting requirements of Paragraph 4.2.3.1.
   2. If proper field test data is not available, establish mixture proportions based on trial mixtures prepared by an independent testing laboratory following procedures set forth in ACI 301, Paragraph 4.2.3.4.b, with required average compressive strength as set forth in Table 4.2.3.3.b for each specified concrete strength.

B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer. Include moisture vapor reduction admixture (MVRA) as specified above

C. Normal Weight Concrete:
   1. Compressive Strength: 4,000 psi, unless otherwise noted in Structural Notes for each application/usage.
   2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight, subject to approval of Structural Engineer.
   3. Water/Cement Ratio: 0.45 unless otherwise indicated in Structural Notes.
   4. Air Entraining Agent & Water-Reducing Admixtures
      a. Do not pre-mix air entraining agent with water-reducing admixtures; add separately from separate container.
      b. All concrete shall contain the specified water-reducing admixture. Mix in conformance with ASTM C494 and in strict accordance with manufacturer's instructions.
      c. Add air entraining agent to all concrete for exposed exterior work including walks, slabs, and the like, to attain a 5% entrained air content; reduce water content but maintain cement quantity.
   5. Slump In Inches
      a. All concrete shall have a maximum slump of 4 inches (+/-1 inch).
      b. Conform to ASTM C143 procedures for concrete to be vibrated.

D. Workability: Workability of concrete shall be such that concrete can be handled, placed and worked into angles and corners of forms and around reinforcing steel and inserts without segregation and without excessive bleeding. Minor adjustments in agreed proportions may be made by the concrete supplier to insure optimum proportioning. No change in the cement factor shall be permitted without approval.

2.09 MIXING

A. General
   1. Concrete for minor work, when approved by the Architect, may be mixed at the site in a power mixer when the mixer has a capacity not less than one full sack batch.
   2. All other concrete shall be ready-mixed as specified below.

B. Ready Mixed Concrete: Ready-mixed concrete shall be measured, batched, mixed and delivered to the project in accordance with ASTM C94. The ready-mixed concrete producer shall furnish legible duplicate delivery tickets for each batch of concrete delivered to the project.

C. Concrete Consistency
   1. Use the amount of water established by the approved mix design.
      a. Do not exceed the maximum quantity specified for the grade of concrete.
      b. Use the minimum amount of water necessary to produce concrete of the workability required by the Architect.
      c. Do not supplement predetermined amount of water with additional water for any reason.
   2. Measure concrete consistency by ASTM C143 method.

PART 3 - EXECUTION

3.01 FORMWORK

A. Construction - Formwork
   1. General:
      a. Construct formwork for new bench units. Construct so concrete members and structures are of correct sizes, shapes, lines, and dimensions shown.
      b. Make reasonably tight to prevent excess leakage of cement paste during concrete placement. Solidly butt joints, and provide backup material at joints as required to prevent leakage and prevent fins.
      c. Keep forms moist prior to pour to prevent shrinkage and warping.
      d. Do not damage concrete during stripping. Permit removal of remaining principal shores.
   2. Corner Treatment:
      a. Chamfer salient corners in exposed concrete. Unless shown otherwise, form chamfers with 3/4 inch x 3/4 inch strips, accurately formed and surfaced to produce uniformly straight lines and tight edges.
      b. Extend terminal edges to required limit, and miter the chamfer strips at changes in direction.

3.02 PREPARATION

A. Fills Under New Building Infill Slabs
   1. Backfill with native or imported structural fill and capillary break base materials specified above, to rough grade elevations; compacted to 95% minimum of maximum dry density as determined by ASTM D1557.
   2. Place capillary break layer specified above, to a 4 inch minimum compacted thickness, unless otherwise indicated.

B. Vapor Retarding Membrane At New Interior Slab Infills: Install vapor retarding membrane over granular capilary break, under new interior slab infills. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

C. Surface Conditions: Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

D. Mixing And Placing
   1. Conform to the requirements of ACI 301, Chapters 7 and 8.
   2. Clean free of all foreign matter and ice, all mixing and transporting equipment, subgrade and forms to receive concrete.
   3. Clean reinforcement of deleterious coatings and ice.

E. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

F. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

C. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

D. Finish slabs level and flat, except where indicated to slope to drain, with outside edges flush with adjacent in-place slabs.

3.05 FINISHING FLAT WORK SURFACES

A. Finishing Slabs - General
   1. For tolerances not indicated, refer to ACI 117-06.
   2. All slab patch surfaces shall be finished flush with adjacent existing slab.
   3. Replace slabs with excessive shrinkage cracks and those not properly finished to floor flatness and leveling tolerances specified above, as approved, without additional cost to Owner.

B. Slab Finishes
   1. Unless otherwise shown, scheduled or specified hereinafter, use the following finishes, as applicable:
      a. Furnish smooth troweled finish for new interior floor slab infills as well as new holding cell benchtop units.
   2. Before finishing work begins, place, strike off, consolidate and level concrete to condition ready for finishing.
   3. Finished surfaces true with tolerance in any direction of not to exceed 1/8 inch in 10 feet. Slope slabs evenly to drains where slopes and/or drains are indicated, not less that 1/8 inch each linear foot.

C. Floating
   1. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further until ready for floating.
   2. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.
   3. During or after the first floating, check the planeness of the surface with a ten foot straightedge applied at not less than two different angles.
   4. Cut down high spots and fill low spots.
   5. Refloat the slab immediately to a uniform sandy texture.

D. Troweled Finish
   1. Provide a floated finish as described above, followed by a power troweling and then a hand troweling.
      a. Produce an initial surface which is relatively free from defects, but which still may show some trowel marks. Provide hand troweling when a ringing sound is produced as the trowel is moved over the surface.
      b. Thoroughly consolidate the surface by hand troweling.
   2. Provide a finished surface essentially free from trowel marks, uniform in texture and appearance.
   3. On surfaces intended to support floor coverings, use grinding or other means as necessary and remove all defects of such magnitude as would show through the floor covering.

3.06 CURING AND PROTECTION

A. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than 7 days.

B. Protection Blankets For Curing Interior Slabs: Install appropriate sheeting as specified above, installed over slabs immediately upon completion of surface finish work as work proceeds. Lap 3 inches and tape or otherwise seal edges and hold down by adequate means to prevent dislodgment. Maintain covering until removal for flooring process. Maintain membrane upkeep until full removal.

3.07 DEFECTIVE CONCRETE

A. Defective Concrete: The following concrete will be deemed to be defective, and shall be removed promptly from the job site.
   1. Concrete which is not formed as indicated, is not true to intended alignment, is not plumb or level where so intended, is not true to intended grades and levels.
   2. Has voids or honeycombs that have been cut, resurfaced, or filled, unless with the approval of the Owner.
   3. Does not have the specified finish, or reveals.
   4. Has cracking which is more than minor hairline cracks, and which are unacceptable to the Owner.
   5. Or does not conform fully to the provisions of the Contract Documents.

B. Repairs & Replacements
   1. Defective concrete may be cut out and repaired with gunite, or other approved methods, when and as directed by the Owner.
   2. Where defective concrete is found after removal of the forms, cut out the defective concrete, if necessary, and make the surfaces match adjacent surfaces.

3.08 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mortar and grout for new CMU walls and infills.

1.02 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: Installation of mortar and grout.

B. Section 08 11 13 - Hollow Metal Doors and Frames: Hollow metal door frames installed in masonry.

1.03 REFERENCE STANDARDS

A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2018.

C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

D. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.

E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.

G. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2017.

H. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.

I. ASTM C476 - Standard Specification for Grout for Masonry; 2018.

1.04 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

PART 2 PRODUCTS

2.01 MATERIALS

A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
   1. Type: Type S.
   2. Color: Standard gray.

B. Portland Cement: 1.
   1. Type: Type I - Normal; ASTM C150/C150M.
   2. Color: Standard gray.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.

E. Grout Aggregate: ASTM C404.

F. Water: Clean and potable.

2.02 MORTAR TYPES FOR UNIT MASONRY WORK

A. General
   1. All mortar compressive strengths and types listed hereinafter for various uses shall be those conforming to and referenced in ASTM C270 for mortar for brick masonry and CMU block setting mortar.
   2. Measure materials for mortar in method that specified or designed proportions can be controlled and accurately maintained.

B. Compressive Strengths:

Mortar Type ASTM C270	Average Compressive Strength at 28 Days psi
S	1800

2.03 GROUT TYPES FOR REINFORCED MASONRY WORK

A. General
   1. Grout compressive strengths and types listed hereinafter for various uses shall be those conforming to and referenced in ASTM C476.
   2. Design to attain (1) minimum compressive strength of 2500 psi in 28 days, average of three 3-1/2 x 3-1/2 x 7 inch cubes, (2) water retention (flow after suction, min., percent of original flow) of 70, and (3) air content (volume, max. percent) of 18.
   3. Measure materials for grout in method that specified or designed proportions can be controlled and accurately maintained.

B. Grout Proportions (Parts) By Volume (C476)
   1. Fine Aggregate Grout:
      a. Portland cement: 1
      b. Hydrated lime or lime putty: 0 to 1/10
      c. Fine aggregate, damp, loose: 2-1/4 to 3 times sum of cement and lime

2.04 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with 1 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. If water is lost by evaporation, re-temper only within two hours of mixing.

2.05 GROUT MIXING

A. Mix grout in accordance with ASTM C94/C94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine grout.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that inside of hollow metal door frames to be grouted are coated with bituminous coating, prior to installation of grout specified below.

B. Coordinate frame anchor placement with wall construction.

3.02 APPLICATION

A. Mortar Types & Uses: Use Type S mortar for all concrete masonry unit wall work.

B. Grout Types & Uses: Use fine grout for grouting voids of all concrete masonry unit work and for grouting all hollow metal frames set in masonry construction.

3.03 INSTALLATION

A. Install mortar and grout to requirements of section(s) in which masonry is specified.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not install grout in lifts greater than 16 inches (400 mm) without consolidating grout by rodding.

D. Do not displace reinforcement while placing grout.

E. Remove excess mortar from grout spaces.

3.04 GROUTING

A. Perform all grouting by means of low-lift technique. Do not employ high-lift grouting.

B. Low-Lift Grouting:
   1. Limit height of pours to 48 inches (1200 mm).
   2. Limit height of masonry to 16 inches (400 mm) above each pour.
   3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
   4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

C. Grout hollow metal frames to be set in masonry construction, using hand trowel methods.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fully grouted and reinforced interior concrete masonry unit walls and bench units.

B. Masonry block reinforcing.

1.02 RELATED REQUIREMENTS

A. Section 04 05 11 - Masonry Mortar & Grout.

B. Section 08 11 13 - Hollow Metal Doors & Frames: Embedded anchors for hollow metal frames; to be embedded into new masonry wall construction under work of this Section.

C. Section 09 91 00 - Paints & Coatings: Interior painting systems for certain CMU wall surfaces.

D. Section 09 96 56 - Epoxy Coatings: Interior epoxy coating applied to designated CMU wall surfaces.

1.03 PRODUCT DELIVERY, STORAGE & HANDLING

A. Material Delivery, Storage, Protection & Breakage
   1. Deliver all materials dry; store all new and re-useable materials at site off ground, adequately covered to protect from moisture and other damage until placed in the work.
   2. Contractor shall allow for and discard all chipped or broken masonry.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete Masonry Block Units (CMU)
   1. Furnish ASTM C90 Type I moisture controlled units of medium weight with sand and gravel aggregate, f'c = 1900 for block units; 8 inch x 16 inch standard face size; 8-inch thick block stock stretcher and half size units in square edge configuration, all as required for the work.
   2. Furnish all units with smooth-faced natural gray colored finish.
   3. Furnish bond beam units for continuous bond beam courses as shown or otherwise required at door openings.

B. Bar Positioners for Fully Grouted CMU: Furnish Hohmann & Barnard, Inc. "RB" Rebar Positioner or Wire-Bond "Corelock" double rebar vertical bar positioners, or approved, hot dipped galvanized.

C. Bars For Vertical & Horizontal Reinforcing
   1. Furnish vertical and horizontal reinforcing of ASTM A615 Grade 60 steel reinforcing bars, of sizes and quantities shown for walls and tying to steel dowels set into surrounding wall structure; furnish as shown and noted on Drawings and related Details. Furnish of #4 size where not otherwise noted.
   2. Vertical bars to be of lengths and laps as required for low-lift grout work in lifts not exceeding five feet; length of bar laps as shown on Drawings.
   3. Furnishing and placement of dowels associated with masonry work, to be set into concrete structures as indicated on Drawings, shall be the responsibility of masonry subcontractor for work of this Section.

D. Deformed Bar Anchors: Furnish deformed bars meeting requirements set forth in ASTM Standard A496; #4 size unless otherwise indicated on Drawings.

E. Dowel Bar Adhesive: Furnish vinylester blended anchor adhesive of appropriate type specified in Structural Notes, for setting in existing concrete floor slab and CMU wall conditions.

F. Cleaning Solution: Furnish as recommended by masonry manufacturer for the various masonry types and colors, as approved.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspection Of Prior Work
   1. Inspect bearing surfaces and related work in place for existing conditions.
   2. See that dowels, masonry anchors, shelf angles and weld plates, as applicable, are properly placed.
   3. If deficiencies or errors are found, notify those trades responsible that corrections are made as approved before starting work.

3.02 PREPARATION

A. General
   1. Clean top surfaces of bearing surfaces and work in place removing all foreign material before starting or resuming work.
   2. Wet concrete masonry units only as required to assure watertight mortar joint bond.

B. Steel Dowels:
   1. Install steel dowel bars for connecting new rebar reinforcement to existing floor and wall structures as shown, of sizes, length and spacing as indicated on Drawings.
   2. Install using epoxy adhesive as specified above or otherwise noted on Drawings, following manufacturer's recommendations for all installation requirements.

3.03 MASONRY INSTALLATION

A. Workmanship, General
   1. Except as otherwise noted or indicated, lay all work to true plumb and level lines, maintaining and aligning with existing coursing patterns at each opening infill.
   2. Use stock units wherever possible; where cutting is required use high speed masonry power saw. Masonry units utilized on an exposed finish surface shall be free of chips, breakage, or other imperfections.
   3. Unless otherwise noted, lay all masonry work in a full bed of mortar, head and vertical joints completely filled.
   4. Use mortar type specified under Section 04 05 11 for the work as described hereinafter.
   5. Make all joints approximately 3/8 inch width. Tool joints smooth with steel tool, leveled flush with face of masonry units.

B. Built-In Work: As the work progresses, build in built-in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items. Extend drainage piping at bench units into gravel as shown.

C. Concrete Masonry Block Unit Installation
   1. General:
      a. Lay units by face shell bedding method, in running bond with head joints conforming to IBC Section 2104, of masonry types, face patterns, and size courses as indicated on Drawings for the various wall structures. Install with all open cells placed vertically.

b. Lay continuous bond beam courses in locations indicated.
c. Make all joints approximately 3/8 inch width.
d. Anchor units to wall and floor structures as shown.

2. Built-in Work:
   a. As the work progresses, build in built-in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.
   b. As work progresses, fill hollow metal frames solid with grout. Leave space between hollow metal frames and exterior masonry for subsequent application of sealant.
3. Finishing Mortar Joints: Tool all joints smooth with steel tool, leveled flush with face of masonry units.

D. Installation Of Masonry Reinforcing: Install deformed reinforcing steel bars vertically in cells of concrete masonry unit infill work, sized and spaced as shown. Engage reinforcing with bar dowels as shown. At new bench units, extend reinforcing back to backup wall as shown for embedment in subsequent cast-in-place benchtop slabs.

E. Low Lift Grout Work: Install grout specified in Section 04 05 11 in low lifts not exceeding 4 feet, completely filling voids of CMU around vertical reinforcing, anchors, weld plates, etc.; at all bond beams install grout around horizontal reinforcing, completely filling bond beam voids. Install grout in cells of masonry units which are to receive wall mounted items and anchored with expansion type anchor bolts.

3.04 POINTING & CLEANING

A. Pointing: On completion of new work, point all exposed masonry work surfaces filling all holes and cracks. Remove all loose mortar and defective work and re-point as approved.

B. Cleaning: Clean all surfaces of concrete masonry unit surfaces which are to be left exposed and painted.

C. Cleaning
1. Clean all surfaces of concrete masonry unit surfaces which are to be left exposed and painted. Clean surfaces with cleaning solution specified above.
2. Wet surfaces with water before applying cleaning solution; after application of cleaning solution, water rinse all solution off the surface.
3. Protect adjacent materials from damage from cleaning solution.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire retardant treated wood and plywood materials for new mechanical equipment curbs.

B. Concealed FRT wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

A. Section 07 50 00 - Membrane Roofing Patch/Repair.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Mechanical curb flashings.

1.03 REFERENCE STANDARDS

A. APA PRP-108 - Performance Standards and Qualification Policy for Structural-Use Panels (Form E445); 2001.

B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.

E. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; 2016.

F. PS 1 - Structural Plywood; 2009.

G. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.

H. PS 20 - American Softwood Lumber Standard; 2010.

I. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2004, and supplements.

J. WWPA G-5 - Western Lumber Grading Rules; 2011.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 - PRODUCTS

2.01 ROUGH CARPENTRY MATERIALS

A. Framing Lumber Grades
   1. Furnish the following lumber species and grades for the work specified below, of nominal sizes shown or specified:
      a. Blocking, Backing, and Furring: Douglas Fir-Larch "No. 2" or Hem-fir "No. 1", S4S.
      b. Wood Roof Mounted Equipment Curbs: Douglas Fir-Larch "No. 3", S4S.
   2. Fire retardant treat all rough carpentry members as specified below.

B. Plywood Grades
   1. Unless otherwise shown or specified, conform to grades of PS 1 for the following:
      a. Plywood Sheathing - All Uses: APA, Structural I, Exp. 1, grade "C-D" with exterior glue, 3/4 inch thickness with panel span rating of 48/24 unless otherwise shown.
   2. Fire retardant treat all plywood as specified herein
   3. Apply APA Grade stamp on all plywood.

C. Nails, Screws & Bolts:
   1. Furnish carbon steel bolts, square head, Fed. Spec. FF-B-575C, Type I furnished with square nuts, unless noted otherwise on Structural Drawings.
   2. Furnish lag bolts Fed. Spec. FF-B-561C, Type I Grade A, gimlet point, square head, unless noted otherwise on Structural Drawings.
   3. Furnish nails, Fed. Spec. FF-N-105B(3), INT AMD 4, Type II, Style as specified and as approved, unless noted otherwise on Structural Drawings.
   4. Provide all necessary nails, spikes, screws and bolts with nuts and washers required for proper installation of rough carpentry and carpenter's steel items.
   5. Hot-dip galvanize hardware for exterior work or exposed to moisture. All fasteners in contact with preservative treated wood shall be hot-dipped galvanized or stainless steel.

2.02 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Lumber and Plywood: Mark each piece of lumber and plywood with producer's stamp indicating compliance with specified requirements.

B. Fire Retardant Treatment:
   1. General: Include all lumber and plywood items as specified below.
   2. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Fire retardant treat all lumber and plywood members associated with new roof deck mechanical equipment curb assemblies.
      b. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Coordinate placement of equipment curbs with mechanical subcontractor for exact size and location of curb members.

C. Discard units of material with defects which might impair the quality of the work and units which are too small to fabricate the work with minimum joints or the optimum joint arrangement.

D. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.

E. Securely attach carpentry work to substrates by anchoring and fastening as shown and as required by recognized standards. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required.

F. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet unit complete with countertop, side and back splashes, and hardware.

B. All new casework items shall meet or exceed the standard of construction and material quality set forth in AWS Section 10 "Casework", Custom Grade with 'Flush Overlay" construction.

1.02 RELATED REQUIREMENTS

A. Section 09 65 00 - Resilient Flooring: Rubber base applied to casework base.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2009.

B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.

D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

E. PS 1 - Structural Plywood; 2009.

F. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2010.

1.04 DEFINITIONS

A. The following definitions apply to work of this Section.

1. Exposed Exterior Surfaces: As defined in AWS Section 10, Paragraph 1.2.10.1 as all exterior surfaces exposed to view including: All surfaces visible when doors and drawers are closed, including knee spaces; underside of cabinet bottoms over 42 inches above the finished floor including cabinet bottoms behind light valances and the bottom edge of light valances; cabinet tops under 80 inches above the finished floor, or if 80 inches and over and visible from an upper building level or floor; visible front edges of stretchers, ends, divisions, tops, bottoms, and shelves.
2. Exposed Interior Surfaces: As defined in AWS Section 10, Paragraph 1.2.10.2 as all interior surfaces exposed to view in open casework or behind transparent doors including: Shelves including edgebanding; divisions and partitions; interior face of door and applied drawer fronts; interior face of ends (sides), backs, and bottoms (including pull-outs). Also includes interior surfaces of cabinet top members 36 inches or more above the finished floor.
3. Semi-Exposed Surfaces: As defined in AWS Section 10, Paragraph 1.2.11 as those interior surfaces only exposed to view when doors or drawers are opened including: Shelves including edgebanding; divisions; drawer sides, sub-fronts, backs, and bottoms; the underside of cabinet bottoms between 24 inches and 42 inches above the finished floor; security and dust panels or drawer stretchers; interior face of ends (sides), backs, and bottoms (including a bank of drawers). Also includes interior surfaces of cabinet top members 36 inches or more above the finished floor.
4. Concealed Surfaces: As defined in AWS Section 10, Paragraph 1.2.12 as those exterior or interior surfaces that are covered or not normally exposed to view.

1.05 SUBMITTALS

A. Shop Drawings
   1. Submit shop drawings for casework, showing location of each item, dimensioned plans and elevations, large scale details, anchors and other components. Indicate compliance with specified standards and other specified requirements for materials and workmanship.
   2. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot.

B. Manufacturer's Data: Submit manufacturer's specifications and installation instructions for hardware, plastic laminates, and other materials used in the fabrication of casework, as required to show compliance with these specifications.

C. Samples: Submit verification samples of minimum 6"x6" size of the following items required in the casework. Samples will be reviewed for appearance and finish only. Compliance with other requirements is the exclusive responsibility of the Contractor.
   1. Plastic Laminate: Submit three 6"x6" sized laminate samples, of each type laminate specified.
   2. Edge Banding: Submit 3 samples of each available color, minimum 3 inches long.
   3. Hardware: Submit one sample of each hardware item.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Except as otherwise noted, all work in this Section shall be fabricated by one manufacturer and installed by, and under the control and supervision of, the casework manufacturer.

B. Quality Standards: Except as hereinafter specified, for materials and workmanship conform to "Architectural Woodwork Standards" ("AWS") of the Architectural Woodwork Institute, 46179 Westlake Drive, Suite 120, Potomac Falls, VA 20165, hereinafter called "AWI".

C. Dimensions: Verify dimensions by field measurement before fabrication, wherever possible, without delaying the project. Design units to provide for adjustment and fitting of components during field installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Storage & Protection
   1. Protect casework during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
   2. Stack level, off floor in millwork plant, during delivery and after delivery to the building.
   3. Do not deliver casework until painting, wet work, grinding and similar operations which could damage, soil or deteriorate casework have been completed in installation areas; if, due to unforeseen circumstances, casework must be stored in other than installation areas, store only in areas which meet the requirements specified for installation areas.

1.08 FIELD CONDITIONS

A. Examination of Substrate & Conditions
   1. The Installer shall examine the substrate and the conditions under which the work under this section is to be performed.
   2. Do not proceed with work under this section until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Coordinate with Contractor for location of backing between studs in walls required for casework installation and anchorage.

PART 2 - PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.

2.02 WOOD- & PLASTIC-BASED COMPONENTS

A. Lumber:
   1. General: Woods used in the unexposed parts shall be suitable softwoods, sound throughout.
   2. Wood moisture content:
      a. Provide kiln-dried lumber with a 5% to 11% average content range.
      b. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for cabinetwork at time of installation do not exceed the following:
         1) Average moisture content not to exceed 8%.
         2) Moisture content range of 5-10% permitted in individual pieces.
   3. Framing: Shall be of solid softwood, kiln dried to above specifications and selected for strength and quality. Stock shall be a minimum of 3/4 inch in thickness.
   4. Joinery: All joints shall be securely glued, pinned and/or screwed together.

B. Softwood Plywood - General Use
   1. Provide panels conforming to PS 1, Group I Douglas Fir Grade "A" Int. APA rotary cut veneer on exposed face and/or faces with Grade "B" or "C" on concealed face veneers; minimum 5-ply for 3/4 inch thickness.
   2. Do not use plywood for plastic laminate backing.

C. Medium Density Fiberboard: Furnish Roseburg Forest Products “Medex” (541-784-4070) or Arauco "Trupan Vesta NAF MR50" (800-268-9830) FSC certified moisture resistant medium density fiberboard, or approved, conforming to ANSI A208.2, Grade 155, MR50 rated, 47 lb./cu.ft. minimum density, made with binder containing no urea formaldehyde; 3/4 inch unless otherwise indicated or specified.

2.03 HIGH PRESSURE PLASTIC LAMINATE MATERIALS

A. Manufacturers:
   1. Formica Corporation: www.formica.com.
   2. Laminart LLC: www.laminart.com.
   3. Panolam Industries International, Inc\Nevamar: www.panolam.com.
   4. Wilsonart LLC: www.wilsonart.com.

B. High Pressure Decorative (Plastic) Laminates
   1. General Purpose Grade Plastic Laminate:
      a. Furnish NEMA Standard No. LD3 Post-Forming Type, HGP Grade, .040 inch thickness (+/ .005”). Solid color or multiple colored pattern as selected by Owner.
      b. Use for all countertops and associated splashes.
      c. Use approved plastic backing sheet .020 inch thickness on bottom side of all tops with an unsupported area exceeding 4 square feet.

2. Vertical Grade Plastic Laminate: Furnish NEMA Standard No. LD3 Type 2 Vertical Grade, .028 inch thickness, for exposed face frames and ends and exposed faces of hinged doors and drawers and exposed faces of open shelving units and exposed end panels, including their exposed edges.
   a. Color/Pattern: Solid color or multiple colored pattern as selected by Owner.
3. Liner Grade Plastic Laminate (PL-2): Furnish NEMA Standard No. LD3 Cabinet Liner (CL5) Grade, .020 inch thick high pressure melamine laminate with matte finish, color White, permanently fused to core under heat and pressure. Use for casework semi-exposed interior surfaces.

2.04 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. PVC Edgebanding: Furnish of 1/8-inch (3mm) PVC edge banding of color matching plastic laminate or HDPE, as applicable; all exposed corners and edges machine finished with 1/8-inch radius

C. Rubber Base: As specified in Section 09 65 13.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

E. Concealed Joint Fasteners: Threaded steel.

F. Sealant: Furnish sealant conforming to applicable specifications of Section 07 92 00, for application to joints between casework units and adjacent wall surfaces.

2.05 HARDWARE

A. Casework Hardware: Provide the following casework hardware, or other manufacturer's equivalent, as required for proper casework construction and operation. Include fastenings and accessories as required.
   1. European Style Hinges: Provide all steel construction with door opening of minimum 125 degree swing, self-closing with 3-way independent screw action adjustment: Hettich #4944, or approved equal. Use for all casework swing doors and for hinged lift-up counter walk-through.
   2. Drawer Slides for Thin Drawers: Provide Knape & Vogt No. 8300 Series zinc-plated, 3/4 extension drawer slide with stainless steel ball bearings, cushioned in and out stops and with minimum 75 lb. load capacity, or approved substitute; no plaster or nylon rollers permitted.
   3. Drawer Slides for all Other Drawers: Provide Knape & Vogt No. 8400 Series zinc-plated, full extension drawer slide with stainless steel ball bearings, cushioned in and out stops and with minimum 100 lb. load capacity, or approved substitute; no plaster or nylon rollers permitted.
   4. Casework Pulls: Provide 4 inch long wire pulls; satin chromium plated.
   5. Magnetic Casework Catches: Provide one of the following or approved:
      a. Knape & Vogt No. 916.
      b. Stanley Hardware Div. No. 46; ALD.
      c. EPCO Magnetic 1000LS.
   6. Shelf Clips: Provide third part heavy-duty shelf clips rated to 400 pounds and designed to resist seismic forces; Bainbridge or approved substitute; provide sample to Owner for review.
   7. Locks:
      a. Provide at casework drawers. Drawer lock shall be dead bolt type, for vertical hand drawer locking. Each lock to be re-keyable using cores matching Owner's Master

Key System; furnish each lock with core and metal strike plate. Finish shall be US26D.

b. Cylinders and locks to be “flush” mounted. Provide shims, spacers and cams as required.

8. Exposed Hardware Finish: Except where specified otherwise or not available, provide exposed hardware with BHMA Code 626 satin chromium plate finish (US26D) where not available, provide either satin aluminum or satin stainless steel finish.

2.06 FABRICATION

A. Fabrication - General

1. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings. Verify all dimensions at building after wall and ceiling finish materials are in place.
2. In this Section, include providing all cabinet hardware required, as specified herein.
3. Unless otherwise noted, provide backs for all cabinetwork.
4. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
5. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
6. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
   a. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

B. Wood Casework - Plastic Laminate Finish

1. Face Construction: Casework shall be of the "reveal overlay" type and shall conform to the additional requirements set forth herein, in addition to meeting or exceeding AWS published specifications for custom casework as specified above and supplemented hereinafter.
2. Exposed Laminate Faced Exterior & Interior Surfaces & Edges:
   a. All vertical face frame surfaces, including drawer and hinged door faces and exposed top and bottom faces of open shelving units and exposed end panels shall be finished with .028 inch high pressure plastic laminate with 1/8-inch (3mm) PVC edge banding of matching color unless otherwise directed; all exposed corners and edges machine finished with 1/8-inch radius.
   b. Edges of doors and drawers shall be finish in 1/8-inch (3mm) thick PVC edge banding as specified above, of color matching door/drawer faces, permanently bonded to core material.
   c. Front and back edges of all interior adjustable shelves in open base and wall hung cabinet units shall be finished with 1/8-inch (3mm) thick PVC edge banding as specified above, permanently bonded to core material.
   d. All exposed interior surfaces of open units shall be finished with liner grade laminate.
3. Countertops: To comply with the following unless otherwise detailed:
   a. Top assemblies to have continuous tops composed of longest section possible.
   b. Joints shall be secured with splines and mechanical fasteners.
   c. Countertop shall be general purpose grade high pressure plastic laminate with .020 plastic backer sheet; color/pattern as selected.
   d. All exposed face and edge surfaces of backsplashes and sidesplashes of laminate tops shall be finished with same laminate as countertops, provided to the various heights indicated, of 3/4 inch thick core material.
   e. Top overhangs shall be as detailed.

4. Miscellaneous:
   a. Furnish complete with all fittings, accessories, and hardware for each unit, all complete in place.
   b. Holes for shelving clips shall be drilled on 1-1/4 inch (32mm) centers, no exceptions.
   c. Structural core of shelves up to and including 30-1/2 inch shelf span shall be 3/4 inch MDF with laminate finish. Structural core of shelves over 30-1/2 inch shelf span and all shelve for book storage shall be 1-inch MDF.
   d. At cabinet backs normally concealed, provide back panels and framing therefor to support weight of cabinets and items to be placed therein; conform to local Code provisions for anchoring casework to resist seismic forces.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examination Of Substrate & Conditions
   1. The installer shall examine the substrate and the temperature and humidity conditions under which the work under this section is to be performed, and notify the Contractor in writing of unsatisfactory conditions.
   2. Verify adequacy of backing and support framing.
   3. Verify location and sizes of utility rough-in associated with work of this section.
   4. Do not proceed with work under this section until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 PREPARATION

A. General: Condition casework to average prevailing humidity conditions in installation areas prior to installing.

3.03 INSTALLATION

A. Casework Installation - General
   1. Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.
   2. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level. Install to a tolerance of 1/8-inch in 8 feet for plumb and level (including tops) and with no variations in flushness of adjoining surfaces; shim as required using concealed shims.
   3. Install cabinets without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.
   4. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.
   5. Install counters in a manner consistent with the specified quality grade to be plumb, level, true and straight with no distortions. Anchor tops securely to base units. After installation of tops, joints shall be carefully dressed and made smooth, surface scratches removed, and entire surface cleaned and polished.

3.04 ADJUST, CLEAN, FINISH & PROTECTION

A. Clean and adjust hardware.

B. Repair damaged and defective casework where possible to eliminate defects functionally and visually; touchup any abraded factory-finished surfaces to match the original finish. Where not possible to repair, replace casework. Adjust joinery for uniform appearance.

C. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures manufactured cabinets and casework being without damage or deterioration at time of substantial completion.

D. Touchup of surfaces damaged by others after completing casework installation shall be performed at the expense of the trade causing such damage.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Acoustical batt insulation at new interior wall framing.

1.02 RELATED REQUIREMENTS

A. Section 09 22 16 - Non-Structural Metal Framing.

B. Section 09 29 00 - Gypsum Board.

1.03 PRODUCT DELIVERY, STORAGE & HANDLING

A. Delivery & Protection Of Materials: Deliver materials in unbroken containers labeled with manufacturer's name and "R" value. Do NOT break seals or use materials until inspected by Architect.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Mineral Fiber Sound Blankets: Furnish unfaced mineral rock wool or glass wool blankets conforming to ASTM C665 Type I, equal to Owens Corning “Sound Attenuation Batts”, or USG Interiors "Thermafiber" batts, or Manville "Sound-SHIELD Sound Control" batts, 3-1/2 inch thickness for setting in new interior steel stud wall framing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mineral Wool Blankets - Sound
   1. In Framing: Fit tight between metal stud wall framing at new interior walls; fit tight around in-wall utilities.
   2. At Door Openings: Pack cut strips tight of sound insulation between wall studs and door frames at head and jambs.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. In general, provide preparation (cutting) and patching of existing membrane roofing assembly for portions of existing roofing at locations of new mechanical equipment curb penetrations.

1.02 RELATED REQUIREMENTS

A. Section 02 41 19 – Selective Building Remodel Demolition.

B. Section 06 10 00 - Rough Carpentry: New wood curb assemblies for new rooftop mechanical equipment.

C. Section 07 62 00 - Sheet Metal Flashing and Trim.

1.03 SUBMITTALS

A. Product Data: Provide data indicating membrane materials, flashing materials and surfacing.

B. Shop Drawings: Indicate joint or termination detail conditions, and conditions of interface with other materials.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual.

B. Installer Qualifications
   1. A single Installer ("Roofer") shall perform the work of this section; and shall be a firm with not less than 5 years of successful experience in installation of membrane roofing system similar to that required for this project.
   2. All work pertaining to the installation of the roofing system and associated flashings shall only be completed by applicator personnel trained and authorized by roofing manufacturer in those procedures.

1.05 JOB CONDITIONS

A. Weather Conditions
   1. Work shall not proceed under conditions of inclement weather such as precipitation or high winds, or when such conditions appear imminent.
   2. Proceed with roofing work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

PART 2 PRODUCTS

2.01 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Provide to match the existing roofing materials and assembly to the greatest extent possible and to provide a watertight seal around new equipment curbs. It is assumed that the existing roofing membrane is a 45 mil PVC product. It is possible, however, that the existing roofing membrane is hypalon. In any case, new roofing membrane shall be a 60 mil PVC membrane.

B. Flexible Flashing Material: Same material as membrane.

C. Membrane Adhesive: Furnish manufacturer's recommended contact adhesive for bonding roof membrane and flashing sheets to the applicable substrates. Should the existing membrane be

a hypalon membrane, provide manufacturer's recommended adhesive for adhering new PVC membrane to the existing hypalon membrane.

D. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

E. Sealants: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.

B. Clean existing roofing membrane surface to receive new roofing, ready to receive hot-air welding of new membrane or if necessary, adhesive application of new membrane. Should the existing membrane be hypalon, the existing membrane surfaces to be covered with new roofing membrane shall be primed with appropriate primer for adhesive application.

C. Do not apply roofing membrane during unsuitable weather.

D. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

E. Coordinate the work with installation of new HVAC equipment curbs.

F. Extend new roofing out over existing roofing minimum 12 inches, unless otherwise directed by roofing manufacturer.

3.02 MEMBRANE APPLICATION

A. General
   1. Have a copy of the manufacturer's latest printed specifications at the jobsite for reference.
   2. Rolls of roofing sheet material shall be stored and handled according to the manufacturer's recommendations; they should also be unrolled and laid down according to manufacturer's instructions. Shingle joints on sloped substrate in direction of drainage.
   3. All membrane surfaces to be welded shall be clean and dry; solvent and heat welding shall be according to manufacturer's recommendations.
   4. Seams shall be checked by roofing subcontractor for watertight integrity and sealed the same day.

B. Patch & Repair Membrane Installation - Fully Adhered
   1. Following installation of mechanical equipment curbs, install new membrane tying existing roofing membrane to new PVC membrane counterflashing.
   2. Lay sheets into adhesive and press or roll down to substrate in accordance with the manufacturer's instructions.
   3. Position sheet so as to lap existing membrane sheet 4 inches minimum when hand welding; machine (automatic) welding laps to be 3 inches minimum. Make all joints watertight with approved electric hot air welding equipment approved by the membrane manufacturer.
   4. Width of weld to be approximately 1-1/2 inches.

C. Hot-Air Welding Of Lap Areas
   1. Hand Welding: Hand welded seams shall be completed in three stages. Hot-air welding equipment shall be allowed to warm up for at least one minute prior to welding.

a. The seam shall be tack-welded every 3 feet to hold the membrane in place.
b. The back edge of the seam shall be welded with a narrow but continuous weld to prevent loss of hot air during the final welding.
c. The nozzle shall be inserted into the seam at a 45 degree angle. Once the proper welding temperature has been reached and the membrane begins to 'flow', the hand roller is positioned perpendicular to the nozzle and pressed lightly. For straight seams, the 1-1/2 inch wide nozzle shall be used. For corners and compound connections, the 3/4 inch wide nozzle shall be used.

2. Quality Control of Welded Seams: As specified below.

3.03 FIELD QUALITY CONTROL

A. Quality Control Of Welded Seams
1. All completed welded seams shall be checked after cooling for continuity using a rounded screwdriver or other suitable blunt object by the roofing contractor.
2. Visible evidence that welding is proceeding acceptably is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of black material from the edge of completed joints.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings and counterflashings.

B. Sealants for joints within sheet metal fabrications.

C. Precast concrete splash pads.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry.

B. Section 07 50 00 - Membrane Roofing Patch/Repair.

C. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

B. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Submit verification color samples of pre-finished metal for color approval.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements, hereinafter in this Section called "Standard Manual", together with standard details, except as otherwise indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

1.07 JOB CONDITIONS

A. Coordination: Coordinate metal flashing and trim work with interfacing of the installation of roofing and other adjoining substrate work for proper sequencing of each installation. Ensure best possible weather resistance and durability of the work and protection of materials and finishes.

B. Electrolytic Protection: Wherever metals of different galvanic range are to be in contacts provide industry-approved separation by bituminous paint coats, bitumen saturated felts, or tinning, as applicable and approved.

1.08 WARRANTY

A. Warranty
   1. Furnish prepainted sheet metal manufacturer's standard duly executed 20-year minimum warranty covering color fade, chalk, and film integrity of factory painted sheet metal finish.
   2. Warranty all roof flashings and sheet metal assemblies specified herein watertight and weather-tight for five (5) years from date of substantial completion.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Prepainted Flashing Sheets: Furnish zinc-aluminum coated sheet steel complying with ASTM A792, Grade 40, AZ50 'Zincalume" or "Galvalume" coated; primed on both sides and finished one side with 70% 'Kynar 500' baked-on coating, or approved, 1 mil thickness; 24 gauge thickness unless otherwise noted or specified. Color white.

2.02 ACCESSORIES

A. Solder: Furnish conforming to Fed. Spec. QQ-S-571D, Type AC, Composition Sn50 unless otherwise specified.

B. Soldering Flux: Furnish conforming to Fed. Spec. O-F-506C Type AC or of type recommended by the industry for type of metal being soldered.

C. Fasteners: Stainless steel, same material and finish as flashing metal, with soft neoprene washers.

D. Factory Prefabricated Reglets
   1. Furnish Fry Reglet Corp. "Type SM" surface reglet, or approved, constructed of 24 gauge galvanized steel, complete with 26 gauge galvanized steel pressure fit counterflashing. Surface mounted reglets shall be furnished complete with foam tape and flat bar reinforcement as follows:
      a. Furnish approved butyl-impregnated polyurethane double-stick foam tape of 3/8 x 1 inch size before compression, for continuous application against wall behind surface reglet.
      b. Furnish 1/8 x 1 inch galvanized steel flat bars for continuous reglet fastening reinforcement at face of reglet.
   2. Furnish reglets and counterflashings complete with manufacturer's preformed one-piece inside and outside corners sections, plus end covers for exposed ends of reglets, except where other flashings are provided as part of roofing assemblies.

E. Self-Adhered Flexible Flashing (SAF)
   1. Material and Manufacture: Furnish of one of the following in standard roll width:
      a. Malarkey #401 "Arctic Seal".
      b. Elk Corporation "Film Finish".
      c. GAF "StormGuard HT".
      d. Grace Construction Products "Ice & Water Shield".
      e. CertainTeed Corp. "WinterGuard HT".
   2. Primer: Furnish as recommended by membrane waterproofing manufacturer for application of membrane over wood and metal substrates.

F. Fastening & Miscellaneous Materials

1. Metal, - General: For steel work, furnish of SAE 1010 analysis, except furnish SAE 1018 or 1020 where case hardened materials are required zinc-coat steel fastenings in accordance with ASTM A153 Class D.
2. Screws and Washers:
   a. Unless otherwise noted or shown, furnish of slotted panhead thread forming ASA Type A, of material specified hereinabove, as applicable; use screws for exposed applications.
   b. Where thread-cutting screws are required, use ASA Type B, of material specified hereinabove, as applicable.
   c. For exterior exposed screws, use dished type plain periphery washers of same material as specified hereinabove, as applicable, plus approved neoprene washer under each metal washer.
   d. Lengths and gauges as required and approved for secure and permanent fastening.
3. Bolts, Nuts and Washers:
   a. Except as otherwise noted or shown, furnish standard hexagon head or square head bolts, of sizes shown and required for secure and permanent fastening of the work, of material specified hereinabove, as applicable, complete with flat washers and nuts of same material.
   b. On exterior exposed work, include dished type plain periphery metal washers, of same material as bolt, plus approved neoprene washer under each metal washer.
4. Nails: Furnish large headed annularly grooved nails of materials specified hereinabove, as applicable; use nails generally only for concealed application. Where absolutely necessary to expose nail heads, provide approved neoprene washer under head.
5. Cleats: Same metal and one gauge heavier than sheet being anchored, continuous, punched for anchors spaced 12 inches o.c.
6. Sealant: For all sealant applications associated with sheet metal flashings specified herein furnish as specified in Section 07 92 00.
7. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, non-corrosive, size and gauge required for performance.

2.03 FABRICATION - GENERAL

A. Metal Fabrications - General

1. General:
   a. Comply with details shown, and with applicable requirements of the SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Comply also with material manufacturer instructions and recommendations.
   b. Shop-fabricate work to greatest extent possible. Neatly form all work to size, shape and dimensions shown or required to fit substrates; make all angles and lines in true alignment. Verify all dimensions at the building.
   c. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work.
   d. Unless otherwise specified, fabricate items in 10 feet maximum sheet lengths, as approved, and hold number of joints to a minimum. Shop form, lap, rivet and solder corners and angles into one piece 18 to 24 inches each way from corner or angle.
   e. After soldering, remove all flux or acid with neutralizing chemical, wash surface with water and then let dry, ready for shop painting and installation.

f. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels as indicated, with exposed edges folded back to form 1/2 hems; hem all drip legs of copings and flashings at 45 degrees.

2. Seams: Form material with standing seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

3. Sealant Joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with industry standards.

4. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

B. Form sections true to shape, accurate in size, square, and free from distortion or defects.

C. Form pieces in longest possible lengths.

D. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. General: Examine all surfaces to be covered with sheet metal; report any improper of defective previous work and do not proceed with work under this Section until previous defective work is corrected.

3.03 INSTALLATION

A. Sheet Metal Workmanship

1. Except as otherwise shown or specified, comply with the recommendations and instructions of the manufacturer of the sheet metal being installed, and with SMACNA "Architectural Sheet Metal Manual".

2. Fabricate and install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves and avoidable tool marks, considering the temper and reflectivity of the metal. Provide uniform, neat seams with minimum exposure of solder, welds and sealant. Except as otherwise shown, fold back the sheet metal to form a hem on the concealed side of exposed edges.

3. Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners and expansion provisions wherever possible in exposed work, and locate so as to minimize the possibility of leakage. Cover and seal work as required for a watertight installation.

4. Provide cleat-type anchorages for metal flashing and trim wherever practical, arranged to relieve stresses from building movement and thermal expansion. Erect all work straight, sharp, plumb and level in true plane free of bulges and waves.

5. Install work with laps, joints and seams which will be permanently watertight and weatherproof; make all lap joints with opening away from prevailing winds; laps 3 inches minimum. Install sealant as shown as work proceeds.

B. Factory Prefabricated Reglets
   1. Reglets:
      a. Install "Type SM" surface mounted reglets along new equipment curb walls as detailed, secured to wall structure at appropriate elevation.
      b. Install foam tape continuous behind reglet face and flat bar continuous along face of reglet as specified above, secured to wall structure with lag screws with expansion shields spaced at each end and not more than 18 inches o.c. between.
      c. Apply sealant along top edge, completely filling recess to provide a watertight seal.
   2. Counterflashings: Install continuous along walls with installed reglets as shown, pressure fit securely into place. Install in maximum length possible, keeping joints to a minimum; off-set joints in counterflashing minimum 24 inches from joints of associated reglet member.

C. Install all other miscellaneous flashings shown on the Drawings, securely anchored to adjacent construction.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Includes furnishing and installation of firestopping assemblies for application at all new mechanical and electrical penetrations through fire-rated floor/ceiling and wall assemblies. Such penetrations include piping, ductwork, conduit and the like.

1.02 RELATED REQUIREMENTS

A. Mechanical and electrical penetrations through fire-rated floor/ceiling and wall assemblies, as indicated on mechanical and electrical drawings, to receive firestopping as specified herein.

1.03 QUALITY ASSURANCE

A. Applicator: Application of firestopping shall be performed by qualified, factory-trained applicators having proper equipment and training to complete the installation in accordance with manufacturer's instructions and applicable U.L. Fire Resistance Directory System Nos.

B. Approvals, Listing & Classifications
   1. Firestopping materials and assemblies shall be approved as listed and described in the U.L. Fire Resistance Directory - Volume II, latest edition.
   2. Materials shall also have been tested and conform to the time/temperature requirements of ASTM E119, as well as to ASTM E814, as applicable.

1.04 SUBMITTALS

A. Product Data: Submit product data from firestopping material manufacturer indicating materials to be use in the work and installation instructions.

1.05 PRODUCT DELIVERY, STORAGE & HANDLING

A. General
   1. Deliver in unopened containers, labels intact with complete instructions for use.
   2. Protect all materials from freezing in transit and storage.
   3. Store all materials at a temperature of not less than 40 degrees F. Protect storage space floor from spillage; keep covered at all times.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Firestopping Materials - Mechanical/Electrical Penetrations
   1. Firestopping materials and assemblies shall be approved as listed and described in the U.L. Fire Resistance Directory - Volume II, latest edition, consisting of either intumescent sealant or intumescent firestop collars, or combination thereof, complete with necessary accessory materials such as mineral wool or fiberglass packing and sheet metal sleeves, as applicable, for complete U.L. listed and approved assembly in each case.
   2. Firestopping systems shall conform to both Flame (F) and Temperature (T) ratings as required by local building code. The F rating shall be a minimum of one (1) hour but not less than the fire resistance rating of the wall, floor or ceiling assembly being penetrated.

PART 3 - EXECUTION

3.01 INSPECTION OF SURFACES & CONDITIONS

A. General
   1. Examine all penetrations to be firestopped.

2. Conform to system manufacturer's printed instructions.

3.02 PREPARATION

A. Preparation Of Surfaces: Clean contact surfaces of dust, dirt, grease and other materials which may effect bond of firestopping materials.

3.03 INSTALLATION

A. Application Of Firestopping - Penetrations
   1. Apply firestopping at all penetrations through fire-rated wall and floor assemblies in accordance with applicable U.L. Fire Resistance Directory requirements and manufacturer's printed instructions for all materials required in each case.
   2. Install firestop materials in sufficient depth to achieve required fire endurance rating, filling all holes or voids made by penetrations.
   3. All combustible penetrants (i.e., non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.
   4. Coordinate with plumbing, mechanical, electrical and other trades to assure that all pipe, conduit, cable, and other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops. Schedule and sequence the work to assure that partitions and other construction which would conceal penetrations are not erected prior to the installation of firestops.

B. Cleaning Up: Remove all residue and excess items resulting from work in this Section.

3.04 FIELD QUALITY CONTROL

A. General: Firestopping work shall remain accessible until inspected and approved by the local building official.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

1.02 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

1.03 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.

B. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

C. Manufacturer's Installation Instructions: Indicate special procedures and surface preparation

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain joint sealant materials from a single manufacturer for each different product required.

B. Maintain one copy of each referenced document covering installation requirements on site.

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

D. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.05 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

B. Weather & Temperature Conditions: Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
   1. Do no exterior priming or sealant work when raining or snowing or when moisture therefrom or dew is present on surfaces.
   2. Install sealants only when ambient temperatures are within the limits of 40 to 100 degrees.

C. Environmental Conditions: Do not install solvent based or other high odor sealants in enclosed building spaces or near air intake grills at occupied buildings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   1. Bostik Inc: www.bostik-us.com.
   2. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html.
   3. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us.
   4. Pecora Corporation: www.pecora.com.
   5. Sika Corporation: www.usa-sika.com.
   6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com.
   7. W.R. Meadows, Inc: www.wrmeadows.com.

B. Security Sealant (Pick Resistant):
   1. Dayton Superior Corp.: www.daytonsuperior.com
   2. Euclid Chemical Co.: www.euclidchemical.com

C. Preformed Compressible Foam Sealers:
   1. EMSEAL Joint Systems, Ltd: www.emseal.com.
   2. Sandell Manufacturing Company, Inc: www.sandellmfg.com.
   3. Dayton Superior Corporation: www.daytonsuperior.com.
   4. Tremco Global Sealants: www.tremcosealants.com.

2.02 NONSAG JOINT SEALANTS

A. Hybrid Urethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 35 percent, minimum.
   2. Hardness Range: 20 to 40, Shore A, when tested in accordance with ASTM C661.
   3. Color: Match adjacent finished surfaces.
   4. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).
   5. Uses: All exterior applications.
   6. Manufacturers:
      a. Master Builders Solutions by BASF; MasterSeal NP100: www.master-builders-solutions.basf.us/en-us.
      b. Sherwin-Williams Company; Stampede 100 Low-Modulus Hybrid Urethane Sealant: www.sherwin-williams.com.
      c. Tremco Commercial Sealants and Waterproofing; Dymonic FC: www.tremcosealants.com.

B. Nonsag Tamper-Resistant Sealant: ASTM C920, Grade NS, Class 12-1/2, Uses M, G, and A; single or multi- component.
   1. Type: Epoxy.
   2. Color: Match adjacent finished surfaces.
   3. Applications: Use for the following joints in secure areas.
      a. Joints between door frames and wall surfaces at holding cells.
      b. Joints between holding cell plumbing fixtures and wall surface.
   4. Products:
      a. Pecora Corporation; Dynapoxy EP-1200 Two-Part Epoxy Security Sealant.

C. Acrylic-Urethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; paintable; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 12-1/2 percent, minimum.
   2. Hardness Range: 15 to 40, Shore A, when tested in accordance with ASTM C661.
   3. Color: Clear.
   4. Uses: All interior applications outside of holding cells
   5. Manufacturers:
      a. DAP Products Inc; DYNAFLEX 920 Sealant: www.dapspecline.com.
      b. Sherwin-Williams Company; Shermax Urethanized Elastomeric Sealant: www.sherwin-williams.com.
      c. Top Gun, a brand of PPG Architectural Coatings; Top Gun 400: www.ppgpaints.com.
      d. Tower Sealants, Inc; AU-1 Commercial Construction Sealant: www.towersealants.com.

2.03 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. In general, work under this Section includes all non-detention type hollow metal work, including doors and frames for Doors 203 and 204.

1.02 RELATED REQUIREMENTS

A. Section 04 05 11 - Masonry Mortar & Grout: Grouting of frames set in masonry construction.

B. Section 08 34 63 - Detention Security Hollow Metal doors and frames.

C. Section 08 71 00 - Door Hardware.

D. Section 08 80 00 - Glazing: Glass for doors.

E. Section 09 91 00 - Paints and Coatings: Field painting

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2003 (R2009).

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.

I. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.

J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.

O. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.

1.04 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

B. Shop Drawings: Include the following:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of anchorages, joints, field splices, and connections.
   6. Details of accessories.
   7. Details of moldings, removable stops, and glazing.
   8. Details of conduit and preparations for power, signal, and control systems.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

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

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door Products
   2. Curries Co.
   3. Deansteel Mfg. Co.
   4. Mesker Door
   5. Republic Doors and Frames
   6. Steelcraft.
   7. Stiles Custom Metal.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Non-Detention Hollow Metal Doors and Frames:
   1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements: Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.

3. Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
   a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
9. Exterior Openings:
   a. Thermal Performance - Door Assembly Operable U-Factor and R-Value Ratings: Shall meet or exceed a U-Factor of 0.36, R-Value 2.70.
   b. Air Infiltration: Rate of leakage of the door assembly shall not exceed 0.1 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Exterior Door - Door 204: Thermally insulated, fire-rated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Core Material: Polyisocyanurate, 2 lbs/cu ft minimum density.
   3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
   4. Top Closures for Outswinging Doors: Flush with top of faces and edges.
   5. Door Face Sheets: Flush.
   6. Weatherstripping: Refer to Section 08 71 00.
   7. Door Finish: Factory primed and field finished.

B. Interior Door, Non-Fire Rated - Door 203:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.

d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.

2. Core Material: Kraftpaper honeycomb.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
4. Door Finish: Factory primed and field finished.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Thermal Break Door Frames: Full profile/continuously welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
2. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
3. Weatherstripping: Integral, recessed into frame edge.
4. Manufacturers Basis of Design:
a. CECO Door Products: Mercury Thermal Break TQB Series.
b. Curries Company: Mercury Thermal Break TQ Series.

D. Interior Door Frame, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
2. Frame Metal Thickness For "SHM" Frames: 14 gage, 0.067 inch, minimum.

E. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

F. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (102 mm) high to fill opening without cutting masonry units.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10 , compatible with high performance coatings specified in Section 09 91 00, Paints and Coatings.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch (0.4 mm) dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.06 ACCESSORIES

A. Glazing: As specified in Section 08 80 00, factory installed.

B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

D. Grout for Interior Frames in Masonry: Portland cement grout as specified in Section 04 05 11.

E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install all doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Brace frames so that pressure of grout before setting will not deform frames; grout installed as specified in Section 04 05 11. Do not grout exterior thermally broken door frames.

D. Install door hardware as specified in Section 08 71 00.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General Scope Of Work
   1. Provide complete furnishing and installation of all detention security type doors and door frames, hardware, security glazing and the like, for Doors 201 and 202.
   2. Although not specifically indicated, furnish and install all supplementary items, appurtenance and devices incidental to or necessary for a sound, secure and complete installation.

1.02 RELATED REQUIREMENTS

A. Section 04 05 11 - Masonry Mortar & Grout: Grouting of frames set in masonry construction.

B. Section 07 92 00 - Joint Sealants: Installation of 'pick resistant' epoxy sealants.

C. Section 08 11 13 - Non-Detention Hollow Metal Work.

D. Section 08 71 00: Door Hardware.

E. Section 08 80 00: Glass And Glazing.

F. Section 09 91 00: Paints and Coatings.

1.03 REFERENCES

A. ASTM A366, Steel, Carbon, Cold Rolled, Commercial Quality.

B. ASTM A569, Steel, Carbon, Hot Rolled Sheet and Strip, Commercial Quality.

C. ASTM A167 and A240, stainless Steel Type 304

D. HMMA 863 - Detention Security Hollow Metal Doors and Frames, published by the Hollow Metal Manufacturers Association Division of the Nation Association of Architectural Metal Manufacturers.

1.04 SUBMITTALS

A. Shop Drawings: Manufacturer/Supplier shall provide shop drawings for review and approval which shall include at least the following:
   1. Door and frame elevations and sections.
   2. Schedule of openings including dimensions, gauges, anchors, and fire label requirements.
   3. Location and details of openings in frames or doors.
   4. Manufacturers standard instructions for frame installation and for material handling and storage.
   5. Glazing types and stops.
   6. Specialty items incorporated into DHM, such as security vision panels.
   7. Schedule of reinforcements for hardware items.
   8. When a fire resistance classification is shown or scheduled for steel doors or frames provide fire rated doors with recognized testing laboratory labels affixed. During the submittal process, identify opening which may not receive labels due to hardware, dimensional or other limitations. For such openings, provide certification that the door and frame components have been constructed in accordance with the requirements of the testing laboratory.

B. Testing And Performance
   1. Doors and frames shall meet the following minimum test standards. Manufacturer shall arrange for all testing and compliance with test requirement shall be certified by reports of a

nationally recognized independent testing agency. Test reports shall indicate the construction of the samples tested with sufficient particularity that construction can be verified.

a. Static Load Test: This test is intended to verify the integrity of the door construction system employed by the manufacturer. With a 36' by 84” door panel supported by both ends, and load applied equally one fourth of the distance from each end, the test panel shall deflect not more than 0.58” at the center and shall rebound to not more than 0.10” when load is removed.

Door Gauge	12	14	16
Test Load	14,000#	14,000#	8,000#

b. Rack Load Test: This test simulates a prying attack on a corner of the door. A 36' by 84” test panel is rigidly restrained at one end. A third corner is simply supported. Loads are applied and deflections measured at the fourth corner. Under the following loads, deflection shall not exceed the amounts shown.

Door Gauge	12	14	16
Test Load	7,500#	7,500#	4,000#
Permitted Deflection	3.2	3.2	2.6

c. Door Impact Test: This test simulates a battering attack on a door and frame assembly, using impacts of 200 foot pounds applied to the stop side of the door by a steel pendulum having a 4 square inch hitting surface. 12 and 14 gauge doors shall be secured with a SSCO 1080-1 lock installed in a door pocket. 16 gauge doors shall be secured with a SSCO 2” narrow jamb lock mounted in the frame jamb. Door shall remain closed during testing and shall be fully operable following the test.

Door Gauge	12	14	16
Hits (6” from bolt)	400	400	200
Hits (6” from each hinge)	150	150	*50

*center hinge only

d. Edge Crush Test: this test simulates a crushing attack on the edge of the door, and also demonstrates the door's resistance to buckling across the surface. At the center of the edge of a 36” by 36” flush door panel, apply load using a 1-1/2” diameter steel cylinder. Load shall be perpendicular to the plane of the door. Ends of the test panel shall not be restrained.

Door Gauge	12	14	16
Minimum Load Supported At 0.25” Deflection	8,000#	8,000#	3,500#
Load Supported without Collapse	15,000#	10,000#	6,000#

e. Removable Glass Stop Testing: Prepare a 12 gauge test window frame of 28” by 33” glass opening, and glaze it with a 3/8” steel plate. Security screw used and screw spacing shall be the manufacturer's standards. Subject the test frame to 400 impacts of 200 foot pounds each on the steel glazing panel within 6” of a single corner. Stops must remain in place, and not more than one screw may be broken upon completion.

f. Louver Impact Test: Where louvers by door and frame manufacturer are specified, provide test report demonstrating that louver construction has been subjected to (50) 200 foot pound blows on the louver blades, applied with a steel pendulum having a 4 square inch striking surface, without failure of the louver and without being able to pass a flat, rigid item through the louver upon completion of the test.

1.05 QUALITY ASSURANCE

A. The following suppliers are approved for detention security hollow metal work:
   1. Trussbilt LLC.

2. Habersham Metal Products Co.
3. Forderer Cornice Works.
4. Claborn Manufacturing Co.
5. Sweepers Metal Fabricators Corp.
6. American Steel Products.

1.06 JOB CONDITIONS

A. Field Verification For Detention Hollow Metal & Detention Security Hardware: Detention Security Contractor and Detention Hollow Metal Manufacturer's Representative shall field verify all construction details prior to preparing shop drawings.

B. Coordination With Other Trades
   1. Detention Security Contractor shall be responsible for the execution of the work in strict accordance with approved shop drawings and specifications and be responsible for error in shop and field work.
   2. Likewise, Detention Security Contractor shall be responsible for coordination with work of other trades as being in strict accordance with dimensions and construction shown on approved shop drawings and project Drawings and for correcting errors therein.
   3. DHM supplier shall furnish the Detention Security Contractor with necessary approved shop drawings and setting diagrams of all DHM to be set in place by the Detention Security Contractor.
   4. Detention supplier shall be responsible for delivering his material to the site in time so as not to unnecessarily delay the progress of the work.

C. Cutting Holes In Work For Other Subcontractors
   1. Factory cut necessary holes for installation of mechanical and electrical work in DHM; comply with templates or detail drawing which shall be furnished prior to fabrication and installation of detention work.
   2. In event other subcontractors fail to provide manufacturer with such templates or drawings in time to cut holes at factory, holes shall be cut in field after or during erection at expense of subcontractor requiring them.

D. Embedded / Concealed Materials
   1. Deliver, to job site, all steel and metal members and materials which are to be embedded in concrete or masonry walls, ceilings, and floors for work under this Section.
   2. These items to be installed by the Detention Security Contractor at no cost to the DHM supplier.
   3. DHM supplier shall furnish complete and accurate setting detail drawings for such items.

E. Protection
   1. While installing products, protect adjacent surfaces against damage and stains.
   2. Protect products during and after installation against damage of every nature so that there will be no indication of use or damage at time of final project acceptance.

1.07 WARRANTY

A. Warranties
   1. Warrant that all DHM shall remain free from defects in materials and/or workmanship for two (2) years following date of substantial completion.
   2. Any defective item of work that should be found during the warranty period shall be corrected, be furnished and installed free of charge.

PART 2 - PRODUCTS

2.01 MATERIAL - GENERAL

A. DHM Materials: Doors and frames shall be constructed using new, commercial quality hot or cold rolled steel, or stainless steel as identified in the architectural drawings. Steel used shall be in conformity with Paragraph 1.03 of this Section.

B. Glass Moldings: Where specified or indicated on drawings, doors and frames shall be supplied with removable glass moldings. These shall be formed steel angles of 12 gauge minimum. Where dimensional restrictions preclude use of an angle, offset surface mounted stops may be used. All stops shall have tightly fitted butted or mitered corners and shall be secured with 1/4”-28 pin-torx head security screws no more than 8” on center.

2.02 DOOR CONSTRUCTION

A. General
   1. All door face sheets shall be 12 gauge unless specified differently. All doors shall be formed of hot or cold rolled steel produced in accordance with ASTM A569 or ASTM A366.
   2. Doors scheduled for exterior openings or scheduled into locations subjected to high moisture conditions shall be galvanized in accordance with ASTM A526 (A60).
   3. Manufacturer's door reinforcements and fabrication techniques shall be consistent with, or more substantial than, the construction employed in doors tested to demonstrate compliance with the performance requirements herein.

B. Specific Additional Reinforcement: The following reinforcement requirements shall also be met:
   1. Doors shall be internally reinforced with one of the following systems:
      a. Continuous steel truss design core material, 28 gauge minimum, having truncated triangular sections extending continuously form one door face to the other, spot-welded to each face 2-3/4” o.c. horizontally and 3” o.c. vertically. Core material to extend full height and width of door.
      b. Rolled or formed 1/8” steel channels extending from top to bottom of door and continuous from one door face to the other, spaced not more than 4” o.c. and spot-welded to door faces not more than 3” o.c. vertically.
      c. Continuous vertical hat section, one such hat section welded to each face of the door, 16 gauge minimum, with vertical webs no more than 4' apart, spot welded to faces no more than 3' o.c. vertically. Hat sections shall welded to each other at least every 6” o.c. both sides in order to prevent door separation. An additional full height edge stiffener I the form of a 1/8” channel shall be installed and welded to both faces not more than 4'o.c.
   2. Door edges shall be provided with additional reinforcing to prevent prying or compression attacks on the door edge. The thickness of the door edge, including this reinforcing, shall be not less than 5/32” for 12 and 14 gauge doors and 1/8” for16 gauge doors. This reinforcing must be welded directly to the door edge.
   3. Top and bottom of the door shall be closed with a 12 gauge formed channel, 16 gauge for 16 gauge doors. Top and bottom closing channels shall be welded to the edge reinforcing. Top and bottom of doors shall be finished flush with inverted channels of not less than 14 gauge, 16 gauge for 16 gauge doors.
   4. Hinge reinforcements shall be minimum 3/16” thick of the size and shape utilized in testing. They shall be projection welded to the door edge, and after installation additionally electrically spot welded to the door edge. In addition, a backup channel stiffener of not less than 14 gauge shall be welded to each hinge reinforcing and to each door face, to prevent rocking failure of the hinge reinforcing. Other internal construction tested to meet ASTM F1450 and HMMA 863-04 may be acceptable.

5. Hardware Preparation - Doors shall be reinforced, drilled, tapped and prepared for templated mortised hardware only, in accordance with a final approved hardware schedule and templates provided by the hardware supplier. Where surface hardware is to be applied, doors shall be reinforced only. Reinforcing dimension shall be as follows:
   a. Surface Mounted Hinges - Minimum 3/8” reinforcing.
   b. Mortised hinges and Pivots - 3/16”
   c. Internal Reinforcing for Other hardware - 12 gauge.
6. Observation Vision Panels: Kingsway Group (kingswaygroupusa.com) anti-ligature "Duralux D4403 Vision Panel" with staff key turn control on one side only. Verify key side of door with Owner prior to installation. Glass opening size: 16" x 16".
7. Cuff Port Openings shall have a reinforced hollow metal door section with continuous hinge, recessed door pull and snaplatch integrated into the door construction. Refer to the detail(s) on the drawings.

2.03 FRAME CONSTRUCTION

A. General: All frames shall be 12 gauge minimum. All frames shall be formed of hot or cold rolled steel produced in accordance with ASTM A569 or ASTM A366. Frames for exterior openings or subject to high moisture conditions shall be galvanized in accordance with ASTM A526 (A60). Frames shall be straight, neat in appearance, and free of warpage and buckling. All frame joints shall be welded. Following fabrication, welded areas of galvanized frames shall be re-sprayed with a cold galvanizing product complying with mil spec. P.46105.

B. Frame Details
   1. Jamb, head and sill profiles shall be as scheduled or shown in architectural drawings.
   2. Corner joints shall have all contact edges closed tight with faces mitered and stops butted or mitered. Corner joints shall be continuously welded and the use of gussets or splice plates is unacceptable.
   3. Frames shall have all intersections opened to allow grouting. Provide round factory-punched round grouting holes with loose properly sized covers and backing plates wherever necessary to allow full grout fill of frame.
   4. Frames shall be reinforced, drilled and tapped for all templated mortised hardware only, in accordance with the final approved hardware schedule and templates provided by the hardware manufacturer. Where surface mounted hardware is to be applied, frames shall be reinforced only - all drilling and tapping shall be done by the erector.
   5. Reinforcements shall be projection welded to the frame and shall be MIG welded to the frame at top and bottom of each reinforcing.
   6. Drilling and tapping of frames for surface mounted hinges shall be by field erector, after door is fitted plumb and true into frame.
   7. Other Reinforcements: The following applications shall be reinforced as indicated:
      Lock Bolt Opening Backup12 gauge minimum
      Surface Mount Closers12 gauge minimum
      Concealed Closers3/16” minimum
      Strike Mounting Clips3/16” minimum
   8. Floors clips shall be provided of gauge at least as great as the frame gauge and shall be welded in place at the bottom of each jamb. They shall have two holes for anchoring to floor. If so required, adjustable floor clips shall be provided.
   9. Frames shall be caulked in order to limit leakage of grout at frame openings.
   10. Provide frame anchors as detailed on the drawings.
   11. Mortar guards of not less that 24 gauge steel shall be welded in place at all hardware and operating parts inside frame.

2.04 FABRICATION AND WORKMANSHIP

A. All material shall be smooth and free of surface blemishes. Gauge of frame members and door face sheets shall be as indicated in the architectural drawings. Doors and frames shall be neat in appearance and free from warpage or buckle. Edge bends shall be true and straight.

B. Fabricate angle framing and perform shop installation of glazing stops.

2.05 PRIME PAINTING

A. DHM Doors And Frames: Doors and frames shall receive one coat of the manufacturer's shop primer which shall be compatible with topcoats specified in Section 09 91 00. Prior to painting, doors shall be pressure sanded on both faces to minimize welding marks and to remove dirt or grease. Paint shall be a minimum of 2 mils dry thickness and shall be applied in an even manner without drips or runs, and in accordance with paint manufacturer's specifications

PART 3 - EXECUTION

3.01 HANDLING AND STORAGE OF MATERIALS

A. General: Detention Security Contractor shall receive material at jobsite, unload it, note any damage and file any required freight claims, and store the material, all in accordance with Manufacturer's instructions and in a manner that will avoid damage from construction operation or weather conditions.

3.02 INSTALLATION

A. Frame Installation
   1. Carefully check frames for size, handing, squareness, alignment, twist and plumbness of jambs and lock columns. Conduit connections shall be checked to assure that they have not loosened during shipment. Screw protection, if provided, shall be checked to assure that it has not been removed or tampered with.
   2. Brace frames so that pressure of grout before setting will not deform frames; grout installed as specified in Section 04 05 11.
   3. After grouting is completed close any exposed opening provided by manufacturer to facilitate grouting with steel covers by welding in place, filling and grinding for a flush appearance. Touch up primed or galvanized surfaces where scratches or other damage has occurred during installation.

B. Protection
   1. While installing products, protect adjacent surfaces against damage, stains.
   2. Protect products during, after installation against damage of every nature so that there will be no indication of use or damage at time of final project acceptance.

C. Cleaning/Repairing
   1. Remove manufacturer's temporary labels, protective coatings, marks of identification if provided; thoroughly wash surfaces, remove foreign material, polish metal surfaces.
   2. Exposed finishes shall be free from scratches, dents, permanent discoloration's and other defects in workmanship, material.
   3. Except where use of field applied touch-up paint is allowed, remove and replace damaged parts, surfaces which are not free from imperfections, or which have been damaged during installation or thereafter before time of final project acceptance. Where approved, touch-up damaged areas in shop applied finish with field applied touch-up paint.
   4. Leave entire work in neat, orderly, clean condition.

END OF SECTION

SECTION 087111 - DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract.

1.2 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Sections:

1. Section 064116 "Plastic-Laminate-Faced Architectural Cabinets" for cabinet door hardware provided with cabinets.
2. Section 083463 "Detention Doors and Frames" for door silencers provided as part of detention frames.
3. Section 087163 "Detention Door Hardware" for hardware for detention doors.
4. Section 283111 "Digital, Addressable Fire-Alarm System" for connections to building fire-alarm system.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.

1. Sample Size: Full-size units or minimum 2-by-4-inch (51-by-102-mm) Samples for sheet and 4-inch (102-mm) long Samples for other products.

C. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and

diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to Owner by registered mail or overnight package service.

1.6 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including excessive deflection, cracking, or breakage.
    b. Faulty operation of doors and door hardware.
    c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by descriptive titles corresponding to requirements specified in Part 2.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Baldwin Hardware Corporation.
    b. Bommer Industries, Inc.
    c. Cal-Royal Products, Inc.
    d. Hager Companies.
    e. Ives; an Allegion brand.
    f. Lawrence Hardware Inc.
    g. McKinney Products Company; an ASSA ABLOY Group company.

h. PBB, Inc.
i. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.3 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

D. Lock Trim:

1. Description: Basis-of-Design: Provide To Match Existing County Standard..
2. Levers: Forged or Cast.
   a. Yale 8800 Series: Carmel – CRR Lever.
   b. Sargent 8200 Series: J Lever.
3. Escutcheons (Roses): Forged or Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.
5. Operating Device: Lever with escutcheons (roses).

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

F. Mortise Locks: BHMA A156.13; Operational Grade 1 ; stamped steel case with steel or brass parts; Series 1000.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Yale 8800 or comparable product by one of the following:

   a. SARGENT Manufacturing Company; ASSA ABLOY.
   b. Schlage; an Allegion brand.

G. Vandal Resistant Mortise Locks: BHMA A156.13; Security Grade 1 ; stamped steel case with steel or brass parts; Series 1000.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Yale SL8800 or comparable product by one of the following:

   a. SARGENT Manufacturing Company; ASSA ABLOY.
   b. Schlage; an Allegion brand.

H. Lockset designations (F0_) refer to ANSI/BHMA A156.13 standards.

2.4 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
   a. Best Access Systems; Stanley Security Solutions, Inc.
   b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
   c. Falcon; an Allegion Brand.
   d. SARGENT Manufacturing Company; ASSA ABLOY.
   e. Schlage; an Allegion brand.
   f. Yale Security Inc; an ASSA ABLOY Group company.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; Small Format permanent cores that are interchangeable to the existing County keying system; face finished to match lockset.

1. Number of Pins: Seven.
2. Type: Mortise type.
   a. Rim type where indicated.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.5 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

2.6 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Baldwin Hardware Corporation.
   b. Cal-Royal Products, Inc.
   c. Hager Companies.
   d. Hiawatha, Inc; a division of the Activar Construction Products Group.
   e. Ives; an Allegion brand.
   f. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
   g. Stanley Commercial Hardware; a division of Stanley Security Solutions.
   h. Trimco.

B. Wall Bumpers: Grade 1 ; with rubber bumper; 2-1/2-inch (64-mm) diameter, minimum 3/4-inch (19-mm) projection from wall; with backplate for concealed fastener installation; with concave bumper configuration.

2.7 FABRICATION

A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

    a. Wood or Machine Screws: For the following:

        1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
        2) Strike plates to frames.
        3) Closers to doors and frames.

    b. Steel Through Bolts: For the following unless door blocking is provided:

        1) Surface hinges to doors.
        2) Closers to doors and frames.
        3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.8 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated.
1. Finish and Base Metal Table: (BHMA/US number)

a.	Typical:	630-US32D on stainless steel. 626-US26D on brass or bronze.
b.	Closers:	689-Sprayed AL on covers.

c.	Thresholds:	630-US32D on stainless steel. Mill aluminum.
d.	Weatherstripping:	630-US32D on stainless steel. Clear anodized aluminum.
e.	Cabinets	Enamel on Steel.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

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

3.2 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
   1. Custom Steel Doors and Frames: HMMA 831.
   2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

   1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
   2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Furnish permanent cores to Owner for installation.

E. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

H. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
   1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
   2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DOOR HARDWARE SCHEDULE

A. HW1: Storeroom Function (F07), Locking latchbolt
   Hinges
   Lockset
   Stop
   Kick Plate

END OF SECTION 087111

SECTION 087163 – DETENTION DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and provisions of contract, including General and Supplementary Conditions.

1.2 SUMMARY

A. This Section includes the following:

1. Electrical and Mechanical Security Hardware for Swinging Doors and Gates.
2. Sliding Devices
3. Miscellaneous Hardware for Security Doors
4. Hardware Schedule for Security Doors.

B. Related Sections include the following:
1. Division 04 Section 042000 “Unit Masonry” for anchoring and grouting door frames set in masonry construction.
2. Division 07 Section 079200 “Joint Sealants”
3. Division 08 Section 083463 “Detention Doors and Frames.”
4. Division 08 Section 088853 “Security Glazing.”
5. Division 26 for Electrical requirements.
6. Divisions 27 and 28 for Security Electronic requirements.

1.3 SCOPE AND RESPONSIBILITIES

A. Fully coordinate this Scope of Work with the Scope of Work shown in the contract documents.

B. Under the requirements of this specification, the DEC shall be responsible for furnishing and installing all hardware as specified, in all locations.

1.4 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections. All submittals shall be supplied on USB drive.

B. Product Data: Manufacturer's printed product data and catalog cuts indicating product characteristics, performance and limiting criteria.

C. Shop Drawings: For each type of hardware item: Include plans, wiring diagrams, method of construction, installation and attachment details and other information necessary to show compliance with requirements.

D. Samples: Provide samples of each item of security hardware item as requested by the Architect-Engineer. Samples shall be shipped as directed, to the location as directed, and shall be shipped within 10 days of receipt of notification of the requirement to provide samples. In addition, if required, provide hardware for all mockups. All mockups shall be fully functional, wired to temporary switches prior to Architect-Consultant's inspection.

E. Hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand and function of door hardware.

1. Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:

a. Type, style, **exact** function, size, and finish of each hardware item.
b. Name and manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of each hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.

1) Door numbers and frame types in schedule to match door numbers and frame types shown on Drawings.
2) Hardware sets shall match specified hardware sets found at the end of this specification section. Hardware set extensions (i.e.: "SH1.a") used to signify hardware sets with additional hardware requirements are acceptable.

e. Explanation of all abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for hardware.
g. Door and frame sizes and materials.

2. Submittal Sequence: Submit schedule at earliest possible date, particularly where acceptance of Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.
3. Fire Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard 80. This requirement takes precedence over other requirements for such hardware. Provide only hardware which has been tested and listed by UL bears appropriate label or symbol for the types and sizes of doors required and compliance with the requirements of the required label and function of the opening wherever possible.

F. Keying Schedule: An Owner approved keying schedule shall be provided to the DEC at the time of detention hardware submittal review.

G. Submittal of written confirmation from the hardware manufacturer showing individual field technicians as approved installers shall be required.

H. Operating/Maintenance Manuals: Furnish O&M Manuals, as outlined in Division 1, for all security hardware and all security locking devices. Provide detailed parts lists and cutsheets for all items with mechanical moving parts or electrical components on the approved security hardware schedule. These manuals shall include instructions for the care of the materials, parts list to aid the Owner in ordering replacement parts, as well as instructions for contacting the

appropriate personnel not only during the warranty period, but beyond. Manuals shall also include the final approved key schedule and "as built" shop drawings of all components. The Detention Equipment Contractor must have full time employees trained in the maintenance and repair of this equipment.

I. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentage by weight of postconsumer and pre-consumer recycled content. a. Include statements indicating cost for each product having recycled content.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing and Marking: Each piece of security hardware furnished under this Section shall be packaged and marked according to the hardware set and door number listed in the approved hardware schedule.

B. Deliver all components cartoned or crated to provide protection during transit and job storage.

C. Inspect all components upon delivery for damage. Damages may be repaired, provided the repaired items are equal in all respects to new work and acceptable to the Architect-Engineer; otherwise, remove and replace damaged items as directed.

D. Store all components in a locked storage area for all components deemed necessary by the Detention Equipment Contractor. Do not store any materials directly on the ground or concrete. Provide adequate ventilation and protection to insure materials are kept dry, clean and secure. Store all materials in the manner and order as prescribed by the Detention Equipment Contractor and/or manufacturer.

1.6 COORDINATION

A. Examine the drawings and specifications of other trades whose work may influence the installation and/or operation of the detention hardware. Prior to the start of work, review the project drawings and specifications and coordinate work with all other trades and Divisions of the Specifications affecting Work of this Section.

1. Responsibilities for electrical and mechanical hardware installation shall include the following:

a. Furnish and install door locks, door position switches, limit switches, lock feature switches and push buttons, as required for the system to perform the functions as defined in the "Door Control" section of the Division 28 specifications.
b. Coordinate the integration and interfacing of the products and equipment specified in this section with Division 28 (SSI) specified, and in accordance with shop drawings and submittals approved by the Architect / Consultant.
c. Review all control submittals submitted by Division 28 (SSI) and confirm that all scheduled controls and monitoring will function in accordance with the specified function. **A written confirmation of this review shall be submitted to the Architect / Consultant.**
d. Coordinate the power requirements with all equipment furnished in this section.

1.7 MAINTENANCE

A. Contractor shall furnish spare parts required in each section, packaged to protect parts from damage and to allow for easy storage.

B. Supplier of equipment shall stock replacement parts for each system and be able to replace any part of the system within 24 hours.

PART 2 - PRODUCTS

2.1 GENERAL

A. Security design criteria are based upon the requirements and features of the products listed herein. The use of one manufacturer's numeric designation does not imply other manufacturer's products will not be accepted.

B. Fire Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard 80. This requirement takes precedence over other requirements for such hardware. Provide only hardware which has been tested and listed by UL, bears appropriate label or symbol for the types and sizes of doors required and compliance with the requirements of the required label and function of the opening wherever possible.

2.2 MISCELLANEOUS HARDWARE FOR SECURITY DOORS

A. Acceptable Manufacturers

1. Except as otherwise specified herein the equipment and materials of this section shall be products manufactured by one of the listed manufacturers and must be equal to the part specified in the product description.

B. Products/Manufacturers

1. Hinges: Southern Folger, RR Brink, Portland, Northwest Specialty Hardware, Airteq
2. Pulls: Southern Folger, RR Brink, Airteq
3. Door Position Switches (DPS): Southern Folger, RR Brink, Airteq, Sentrol
4. Door Closers: LCN
5. Door Stops: Ives
6. Thresholds: Reese, National Guard and Pemko
7. Weather-strip: Reese, National Guard and Pemko
8. Smoke Seal: Reese, National Guard and Pemko
9. Silencers: Ives

C. Product Description

1. Hinges, SOUTHERN 204FMSS:

a. Full Mortise Detention Hinges shall be 4-1/2” x 4-1/2” x 0.188” thick investment cast 304 stainless steel with hospital tips and integral studs on both leaves. Pins

shall be hardened stainless or alloy steel, concealed and non-removable. Each hinge shall be supplied with eight (8) ¼-20 flat head machine screws. All hinges and screws shall be US32D finished.

b. Furnish three hinges for door through 84-inches in height and one additional hinge for each additional 30-inches of height or fraction thereof. Furnish three hinges for doors through 36-inches in width and one additional hinge for each additional 12-inches of width or fraction thereof.

c. Except where otherwise indicated, hinges shall be mortised, 4-1/2" x 4-1/2", cast steel or stainless steel, ball bearing, with pins made non-removable by a concealed hardened roll pin. All hinges shall be furnished with 1/4-20 TORX FHMS.

d. Hinges shall be certified, by an independent testing lab, to meet or exceed the cycle requirements of ASTM 1758, Grade 1A.

e. Hinges furnished for use on labeled fire doors shall also comply with the requirements of NFPA 80.

2. Full surface hinges, equal to Southern Folger 203FS/203FP where indicated on architectural details for food pass applications in rated openings.

3. Strikes: All locks and latches shall be furnished with manufacturer's standard strikes complete with dust boxes to fully conceal the strike pocket. Where monitor strikes are specified, provide strikes as appropriate for the lock specified. All monitor strikes shall be designed to fit within a 2" face frame without protruding beyond the 2" frame depth.

4. Fasteners:

a. Manufacturer hardware to conform to published template, generally prepared for machine screw installation. Do not provide hardware, which has been prepared for self-tapping of sheet metal screws.

b. Furnish screws for installation with each hardware item. All exposed screw heads, whether door is open or closed, shall be Torx (with security stud) flat-head or oval head screws except as otherwise indicated. Screws shall be the same material and finished to match the applied hardware item. Other types of security screws are unacceptable unless specifically approved by the Architect-Consultant.

5. Pull:

a. Grip Type Door Pulls shall be cast of brass or bronze with satin finish of approximately US26D unless specified otherwise in hardware schedule. Approximate overall length, 8-11/16”; handhold, 5-1/4”; grip clearance, 1-1/2”; attachment holes, 7-3/4” o.c. Provide two (2) 3/8-16 x 5/8” flat head torx screws of same finish and material as pull.

b. Flush Type Door Pulls shall be cast of brass or bronze with satin finish of approximately US26D unless specified otherwise in hardware schedule. Size 4” x 5” x 1/8” x pocket rip 1” deep. Provide four (4) ¼-20 x 3/8” flat head torx screws of same finish and material as pull.

6. Door Position Switch, SOUTHERN 200MRS, or as required by hardware schedule:

a. Recessed Magnetic Door Position Switch-Triple Biased shall be a five-reed switch magnet mortised type assembly used for remotely monitoring the door status/position. The device shall be triple bias for tamper resistance.

b. The device shall be moisture resistant and fit within a 2" hollow metal jamb or head. The device shall be field adjustable on 2 axis and supplied with a 5' vinyl jacketed lead wire and a 3-pin Molex connector. The device shall be all steel construction. The switch and magnet shall be encased in epoxy resin.
c. Where this device is used in an exterior location, provide a complete water-tight installation.

7. Concealed Door Closers (LCN #2210 series) shall be concealed in surface of door and frame with security screws and shall have fully adjustable spring tension. Maximum opening allowed shall be 180 degrees. Provide standard finish of powder coat aluminum. Closer shall be mounted with Torx head security screws. 2210DPS combo closer is not acceptable.
8. High Security Closer (LCN #4210/4510T series) shall be surface mounted with security screws at all exposed locations and shall have fully adjustable spring tension. Closers shall have cast iron cylinders and two separately adjustable non-critical valves for closing speed and latching speed, plus a third valve for adjusting the hydraulic back-check. A smooth molded case cover shall conceal the closer body. Closer to be located on the side of door/frame farthest from inmate contact, unless an exterior door. Mount closer for exterior doors on interior side of the door. Maximum opening clearance shall be 180-degrees. Parallel arm shall be used on the 4210 series closer, this closer shall be used at all locations not in direct contact with inmates. A track arm shall be used on the 4510T series closer, which shall be provided at dayrooms, and locations with direct inmate contact. Provide finish of standard powder coated aluminum. DEC shall be responsible for coordinating the installation of the closer with jobsite frame installation conditions prior to installation. Closer body shall not be inhibited by, or touch the wall or any other object after installation. If the above conditions cannot be achieved, request direction from the Architect/Consultant, by providing suggested solution using LCN security grade products.
9. Wall Mounted Door Stops **(Wall mount only)** (Ives FS18L) shall be a tamper resistant device that is embedded into the wall with an epoxy resin adhesive. Bumper shall be 2" diameter x 3-1/2" long and made from a non-hazardous silicone elastomer, 80 durometer. The threaded and grooved steel mounting shank shall be 5/8" in diameter and embedded into the bumper at least half the length of the bumper. Mounting shank shall extend 2-1/2" beyond the bumper bottom for embedding into the wall.

   a. Cell Doors: Provide wall-mounted door bumper **80"** off of the floor and 8" from edge of door when in the opened position. If the above conditions cannot be achieved, request direction from the Architect.
   b. All other Security Doors: Provide wall-mounted door bumper **8"** off of the floor and 8" from edge of door when in the opened position. If the above conditions cannot be achieved, request direction from the Architect.

10. Thresholds: Provide thresholds as in "Security Hardware Schedule", and where required on security doors per architectural details. All doors into rated stairways shall be provided with Reese S204A thresholds (or approved equal).

11. Weatherstripping: Provide weatherstripping at all exterior doors equal to Reese DB469C door sweep plus 797B weatherstrip, or approved, at all heads and jambs (and astragals if pairs), After installation, razor cut gasketing into pieces not over 12" in length, installed per manufacturer's recommendations. Do not break weatherstrip at head of frame for

closer installation. SILL SWEEP MUST BE FASTENED WITHIN ½" MAXIMUM FROM EDGE OF DOOR ON EACH SIDE.

12. Smoke/Fire Gasket: Provide head and jamb gasketing equal to Reese 797B weatherstrip and Reese 964C Sill sweep, or approved equal, at all fire and/or smoke rated openings. After installation, razor cut gasketing into pieces not over 12" in length, installed per manufacturer's recommendations. Do not break weatherstrip at head of frame for closer installation. SILL SWEEP MUST BE FASTENED WITHIN ½" MAXIMUM FROM EDGE OF DOOR ON EACH SIDE.

13. Door Silencers: (Ives SR64) shall be standard resilient type and removable for replacement.

14. Head & Foot Bolt, SOUTHERN 10105: Head & Foot bolt to be cold rolled steel plate cover with ductile iron case. Finish to be galvanized. Bolt to be 1" diameter with a ¾" bolt throw.

15. Bolt Receptacle, SOUTHERN 10105R: Receptacle to be 3"H x 1-5/8" diameter x 1-5/8" square base.
    a. Receptacle to be epoxy grouted into floor.

16. Door Peep: Provide a Door Peep as indicated on architectural door schedule and drawings. Peep shall have a 180º minimum view, and through-bolt securely to the opening prepared by the hollow metal manufacturer. Peep shall be a Trimco Door Viewer #976 at non-rated openings and Trimco #976U at rated openings. No substitutions

2.3 MECHANICAL LOCKS FOR SECURITY DOORS

A. Acceptable Manufacturers

1. Except as otherwise specified herein as "No Substitution", the equipment and materials of this section shall be products manufactured by one of the listed manufacturers and must be equal to the part outlined in the product description. Southern Folger is shown in the product description as a design basis only:

    a. Southern Folger Detention Equipment Company (SOUTHERN), San Antonio, TX
    b. RR Brink Locking System (RRB), Shorewood, Ill
    c. Airteq Systems: Madison, AL

B. Mechanical Locks and Accessories for Swinging and sliding Doors

1. Standard Features

    a. Lock case to be high tensile strength alloy steel with cold rolled steel cover
    b. All locks to operate by inserting a key into matching cylinder and rotating key to unlock the lock.
    c. All lock steel parts shall be zinc plated for corrosion protection and are suitable for both interior and exterior applications.
    d. Keyed One Side (K1) or Keyed Two Sides (K2).

e. At rated locations, provide smoke gasketing, weather strip, sweeps, sill threshold, door skirts, plates, angles and/or additional material as required per the manufacturer's recommendations to obtain the appropriate label as per the architectural drawings. This requirement takes precedence over other requirements for scheduled hardware. Provide only hardware which has been tested and listed by UL bears the appropriate label or symbol for the types and sizes of doors required and compliance with the requirements of the required label and function of the opening wherever possible.

C. Product description

1. Mechanical Deadbolt, SOUTHERN 1010A:

a. Lock size to be approximately 4/1/2" x 3" x 1-1/4". Deadbolt to be ¾" x 1-1/2" hot rolled steel with 5/8" throw. Deadbolt locking and unlocking activated by key only.
b. The lock shall be supplied with a six (6) pin paracentric key cylinder.
c. Provide extended bolt throw at food pass locations as required by hollow metal fabrication. DEC shall fully coordinate with hardware and hollow metal manufacturers.

2. Mechanical Latch, SOUTHERN 1017A:

a. Lock size to be approximately 4" x 2-3/4" x 1-1/4". Beveled latchbolt to be 7/16" x 1" stainless steel with 7/16" throw.
b. Beveled latch bolt to be retracted by key operation only. Latchbolt to snap-lock on closing.
c. The lock shall be supplied with a six (6) pin paracentric key cylinder.
d. Provide extended bolt throw at food pass locations as required by hollow metal fabrication. DEC shall fully coordinate with hardware and hollow metal manufacturers.

3. Mechanical Deadbolt, SOUTHERN 1080A:

a. Lock size to be approximately 5-1/2" x 3-3/4" x 1-1/2". Deadbolts to be ¾" x 2" with ¾" throw. Deadbolt locking and unlocking activated by key only.
b. Deadbolt to be made of cold rolled steel with ¼" diameter hardened steel inserts (2 each) unless otherwise specified.
c. The lock shall be supplied with a six (6)-pin paracentric key cylinder.
d. Provide 1-1/2" x 1-1/2" x ¼" x 10" high custom galvanized angle strike to receive lock bolt where installed in fence system. Weld custom strike to fence frame.
e. Provide 3" x 3" gate stop gusset angles where required to stop gate swing. Welded at corners of gate opening.

4. Institutional Mortise Lockset, SOUTHERN 10500:

a. A security mortise lockset for 2" thick individual swing doors that comply with the standard test methods defined in ASTM F1577-05. Locksets shall be supplied with high security rose and functions as specified by the door and/or hardware schedule. Lockset shall be UL listed for use with fire-rated doors where specified.

b. Lockset case and cover shall be 12-gauge (minimum) heavy-duty wrought steel, zinc dichromate plated. Latchbolt shall be one-piece stainless steel anti-friction type with ¾" throw, meeting ANSI A156.13. Deadbolt shall be investment cast stainless steel with hardened steel insert and a 1" throw. Deadlock actuator shall be stainless steel. Strike shall be ANSI standard, universal brass or stainless steel. Faceplate shall be 16 gauge (Minimum) stainless steel, US32D finish.
c. Latchset shall be supplied with solid stainless steel (US32D finish) steel lever handles (both sides) unless otherwise specified.
d. Lockset shall be supplied with high security M5 Style Large Format Mogul Cylinders unless otherwise specified. All exposed fasteners shall be stainless steel tamper proof.
e. **Lock functions must match EXACTLY** with functions specified in individual hardware sets in section 3.4.

5. Galvanized Material

a. All exterior material shall be hot dipped galvanized.

2.4 KEYING AND KEYS

A. Keying and Keys

1. An approved key schedule shall be provided by the DEC at the time of submittal review. It shall be the responsibility of the DEC to schedule a keying meeting with the Owner and Architect/Consultant to determine keying requirements of the Owner for preparation of a key schedule.
2. M5 Style Large Format Mogul Cylinders shall be keyed in sets and master keyed, sub-master keyed etc. to level as directed by the Owner.

a. Provide five (5) keys per master code.
b. Provide eight (8) keys per change key code.

3. Paracentric prison locks shall be keyed in sets and provided with eight (8) keys for each change key code.

B. Key Control System:

1. Keying: Provide a key system as directed by the Owner.
2. The DEC shall be responsible for all keys and in the unlikely event any key is lost, the DEC shall bear all costs incurred in having locks re-keyed. The DEC shall turn all keys over to the Owner as directed by the Owner for inclusion into the key cabinet.
3. When requested by the Owner, in writing, the DEC shall surrender any or all keys assigned to him.
4. All keys shall be stamped with a maximum of six (6) characters, as directed by Owner. Each egress key shall be such that meets the 2006 NFPA-101 Life Safety Code (22.7.5) to identify key(s) by touch and sight.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Examine and inspect all surfaces, anchors, and grounds that are to receive materials, fixtures, assemblies, and equipment specified herein. Check location, "rough in", and field dimensions prior to beginning work. Report all unsatisfactory conditions in writing to the Architect-Engineer and general contractor.

1. Do not begin installation until all unsatisfactory conditions have been corrected.

B. Verify all dimensions and be responsible for their correctness. No extra compensation will be allowed for differences between actual measurements and the dimensions indicated on the drawings.

3.2 INSTALLATION

A. Install security materials and accessories in accordance with the final shop drawings, manufacturer's data, and as herein specified.

1. Provide manufacturer's supervision of installation, including testing and interfacing of systems.

B. Install all components and complete system as indicated and in accordance with manufacturer's recommendations and instructions.

C. Nuts of all bolted work shall be drawn tight and threads battered or welded. Bolting may be used in the installation of detention equipment provided that the nuts are not accessible to inmates or exposed to view. Bolts shall be special oval head or flat head Torx security type. Screws shall be the same material and finished to match the applied hardware item. Other types of security bolts are unacceptable unless specifically approved by the Architect-Engineer. Provide two sets of wrenches for each size bolt used.

3.3 ADJUSTING

A. Final Adjustments: Prior to final inspection check and re-adjust all components to operate within their designed capacity. All components shall be adjusted and tested to verify correct operation prior to final inspection.

B. All devices shall be tested for specified and manufacturer described operation.

C. All tests required by local agencies shall be performed.

D. All tests required by Owner and Owner's representative shall be performed.

E. Systems not meeting the minimum level of acceptability as defined in the test procedures shall be repaired and retested.

F. Provide documentation of test procedures and results.

G. Equipment manufacturer's representative shall certify that the systems are installed and operate as specified.

H. All costs to test and retest systems shall be the responsibility of the Detention Equipment Contractor.

3.4 SECURITY HARDWARE SCHEDULE

A. GENERAL NOTES:

1. Provide smoke & fire rated materials in accordance with 087163.2.2.C.11, 12 and 13, unless otherwise instructed by the Architect/Consultant.
2. Provide threshold, weatherstrip equal to Reese "797B/DB469C" at exterior door openings.
3. **Provide a doorstop equal to Ives FS18L at all door openings in accordance with 087163.2.2.C.10. unless otherwise instructed by the Architect/Consultant**.
4. Any door greater than 3'-2" in width and/or 7'-4" in height shall receive four (4) hinges.

HARDWARE SET NO. SH1

UNIT	PART	CATALOG NO.	FINISH	MANUFACTURER
3EA	HINGE	204FMSS	US32D	SOUTHERN FOLGER
1EA	LOCK	10120AMD-1	US26D	SOUTHERN FOLGER
1EA	CYLINDER	M5 MOGUL	US26D	SOUTHERN FOLGER
1EA	DPS	200MRS-TB	US26D	SOUTHERN FOLGER
1EA	FOOD PASS LOCK	1010A	GALV	SOUTHERN FOLGER
1EA	FOOD PASS HINGE	----	----	BY SHM MFG
1EA	RAISED PULL	212C	US26D	SOUTHERN FOLGER
1EA	RECESSED PULL	INTEGRAL	----	BY SHM MFG
3EA	SILENCERS	SR64	----	IVES

HARDWARE SET NO. SH2

UNIT	PART	CATALOG NO.	FINISH	MANUFACTURER
3EA	HINGE	204FMSS	US32D	SOUTHERN FOLGER
1EA	LOCK	10513*Modified	US26D	SOUTHERN FOLGER
1EA	STRIKE	500CL	US26D	SOUTHERN FOLGER
1EA	CYLINDER	M5 MOGUL	US26D	SOUTHERN FOLGER
1EA	CLOSER	4210/4510T	AL	LCN
1EA	DPS	200MRS-TB	US26D	SOUTHERN FOLGER
1EA	THRESHOLD	S204A	AL	REESE
1EA	WEATHERSTRIP	797B/DB469C	AL	REESE

END OF SECTION 087163

SECTION 088853 - SECURITY GLAZING

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. Security glazing.
2. Glazing accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Division 07 Section 079200 "Joint Sealants” for security sealants.
2. Division 08 Section 081113 “Hollow Metal Doors and Frames.”
3. Division 08 Section 083463 "Detention Doors & Frames."

1.3 SCOPE AND RESPONSIBILITIES

A. Under the requirements of this specification, the DEC shall be responsible for furnishing and installing all glass and glazing accessories, as specified, in all locations, unless indicated otherwise.

1.4 PERFORMANCE REQUIREMENTS

A. Provide security glazing that complies with the requirements listed below as indicated by the test ratings for specific glazing types.

1. H.P. White Laboratory, Inc.; HPW TP-0500.00.
2. American Society for Testing and Materials; ASTM F1915-12.
3. Underwriter’s Laboratories, Inc.; UL 752, UL 972.

1.5 SUBMITTALS

A. General: Submit the following according to Conditions of Contract

B. Product data for each security glazing type, including type of materials, thickness, installation requirements, method of test, and performance. Submit 2 copies of the most recent literature &

cleaning instructions and any other documentation deemed necessary to demonstrate compliance to the specification.

C. Test reports showing compliance with specified requirements. **SUBMITTAL MUST INCLUDE CURRENT UL TEST REPORTS AND CURRENT PHYSICAL ATTACK AND CONTAINMENT REPORTS PER ASTM F1915-12, AND EVERY OTHER ASTM, UL, WMFL, AND HP WHITE REPORT LISTED PER EACH INDIVIDUAL GLASS TYPE SPECIFIED HEREIN.**

D. Certification by manufacturer that products supplied comply with performance requirements specified.

E. Maintenance data covering cleaning and protection requirements to include in the Operation and Maintenance Manual specified in Division 1.

F. **Upon request** of the Architect, submit 2 samples, 12” square, of each type of security glazing product.

G. Submit a composite detail of the glass and frame assembly. This detail shall show and define all products in the assembly including, but not limited to, the following: Frame, glass stop, glass, setting blocks, glazing tape, and sealant. All products used in the glazing composite must be compatible.

H. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentage by weight of postconsumer and preconsumer recycled content. a. Include statements indicating cost for each product having recycled content.

1.6 QUALITY ASSURANCE

A. Comply with ASTM F1915-12 containment test for forced entry performance. Round robin testing is not acceptable.

B. Certified Safety Glazing: Category II products complying with test requirements of 16 CFR 1201 and ANSI Z97.1, certified by Safety Glazing Certification Council, and permanently labeled.

C. Manufacturer Qualifications: Firm with minimum 5 years experience in manufacturing security glazing products that are similar to those indicated for this Project and that have a record of successful in-service performance.

D. Installer Qualifications: Engage an experienced Installer who has a minimum of 5 years experience in installing security glazing similar to that required for this Project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect products according to manufacturer's recommendations. Specifically, avoid damage to glass edges, and prevent damage from temperature changes, sunlight, and moisture.

1. Furnish polycarbonate materials with a strippable water resistant masking paper on exposed surfaces.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Do not install glazing when either air or substrate temperature exceeds the range recommended by sealant manufacturer or when substrate is wet, damp, or covered with snow, ice, or frost.

B. Install bulk sealants only at air and substrate temperatures above 40 deg F (4 deg C).

1.9 WARRANTY – LAMINATED PRODUCTS

A. Warranty: Submit a written warranty, executed by manufacturer, agreeing to replace laminates that delaminate within 5 years from date of Substantial Completion. If delamination damage occurs and upon inspection is found beyond a reasonable doubt to be caused by security sealant contact with raw glazing edge, the DEC shall be responsible for replacing the glazing at their expense.

B. Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Global Security Glazing (Polycarbonate, Laminated Polycarbonate, Glass-Clad Polycarbonate & Fire Rated Glass
2. Sheffield Plastics (Polycarbonate & Laminated Polycarbonate) (Pending Testing)
3. LTI Smart Glass (Glass-Clad Polycarbonate & Fire Rated Glass) (Pending Testing)

B. Acceptable Distributors:

1. Global Security Glazing, Selma, AL (800) 633-2513
2. Allied Protective Glazing LLC., Pittsfield, MA (413) 769-2909 (Pending Testing)
3. Cope Plastics, Hazelwood, MO (877) 528-2594 (Pending Testing)

C. Available Products: Unless pre-approved prior to bidding, provide the products specified.

D. The DEC and glazing manufacturer agree to comply with the requirements as defined in section 3.4 and to provide materials and warranty as required by the contract documents using the materials listed in section 2.5.

2.2 MATERIALS

A. Float Glass:

1. Clear Heat Strengthened Glass: ASTM C 1048, Condition A (uncoated surfaces), Class 1 (clear), Kind HS (heat strengthened).
2. Tinted Heat-Strengthened Glass: ASTM C 1048, Condition A (uncoated surfaces), Class 2 (tinted, heat-absorbing, and light-reducing), Kind HS (heat strengthened), tint color as specified with security glazing type.
3. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Class 1 (clear), Kind FT (fully tempered).
4. Chemically Tempered Glass: ASTM C 1036, Class 1 (clear) chemically tempered; edges seamed prior to tempering
5. ASTM C 1048, Condition A (uncoated surfaces), Class 1 (clear), Kind HS (heat strengthened).

B. Polycarbonate Sheet: Rigid, flat polycarbonate sheet; thickness as indicated.

1. Relative Burning Characteristics: Average extent of burning less than 1 inch, when tested per ASTM D 635, using the thickness of material indicated for Project.

2.3 GLASS-CLAD POLYCARBONATE LAMINATES

A. Type SG1

1. 3/4” clear glass clad polycarbonate laminate, equal to Global Security Glazing Secur-Tem + Poly SP019, or approved equal. H.P. White TP-0500.02 Level IV forced entry, WMFL Level III, ASTM F1915-12 Grade 2 – 40 minute containment, ASTM F 1233 9mm ballistic rating.

1/8” Clear heat strengthened glass
.050” Urethane
1/4” Polycarbonate
.025” Urethane
1/8” Polycarbonate
.050” Urethane
1/8” Clear heat strengthened glass

B. Type SG2 - For Nurse Vision Lites

1. 3/8” clear Tempered glass, ASTM C 1048, Condition A (uncoated surfaces), Class 1 (clear), Kind FT (fully tempered).

2.4 FABRICATION

A. Fabricate glazing with bite and edge clearance dimensions, including tolerances, as recommended by manufacturer and GANA "Glazing Manual." Exception: Where specific bite

dimensions are indicated on drawings, as required for proper securement of glazing in frames, comply with those dimensions.

B. Cut or drill holes in laminated units as required or indicated.

C. Grind exposed edges smooth, using methods recommended by manufacturer.

D. Coordinate speak-port locations as indicated on architectural drawings, with glass manufacturer.

2.5 GLAZING ACCESSORIES

A. Installation Materials-General: Select products that have appropriate performance characteristics as recommended by glazing manufacturer and that are compatible with materials they will contact.

1. Provide a letter from the glass manufacturer that states all glazing materials submitted are compatible with the glass submitted.

B. Glazing Tape:

1. Pre-shimmed, 100 percent solids, polyisobutylene-butyl rubber with internal spacer rod.
2. At fire rated openings, provide Rectorseal Blaze Seal.

C. Glazing Sealant:

1. Provide at exterior side of exterior security glazing only: One part silicone rubber meeting Federal Specification TT-S-00230C, Class A, ASTM C-920 Type S, Grade NS, Class 25; Equal to Dow Corning 795.

D. Security Sealant:

1. Provide at all interior security glazing only: Dynaflex SC. One part non-sag tamper resistant elastomeric STPU meeting Federal Specifications TT-S-00230C, Type II, Class B and ASTM C-920-98, Type S, Grade NS, Class 12.5 as manufactured by Picora. When applying directly to a polycarbonate surface, application area must be primed with Picora P-120 primer prior to use as required per published manufacturer recommendations.

E. Setting Blocks:

1. TPR (Thermoplastic rubber) with 70-90 shore “A” durometer hardness, chemically compatible with glazing components.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine frames and rabbets in which glazing is to be installed for possible damaging conditions. In particular, check for conditions that would void the manufacturer's warranty.

1. Verify that minimum edge engagement of framing is 1 inch (25 mm).

B. Submit Installer's report describing unacceptable conditions.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces to receive glazing just before installing glazing.

3.3 INSTALLATION – GENERAL

A. Comply with recommendations for installation contained in the GANA "Glazing Manual" and "Sealant Manual" except when specifically not recommended or prohibited by the glazing or glazing accessory manufacturer; comply with manufacturers' recommendations.

B. Protect glazing from edge and surface damage during handling and installation.

C. Do not install glazing that has edge or surface damage or defects that reduce glazing strength or diminish appearance.

D. Permanently adhere setting and edge blocks to frame.

E. Do not block weep holes.

F. Applied Stops: Fasten as indicated, after glazing has been set in frame. Do not exert excess force on glazing and glazing spacers.

G. Remove protective masking paper on polycarbonate materials only as required to set glazing.

3.4 TAPE GLAZING

A. Install tape continuously, placed so that when compressed the exposed face will be 1/8 inch (3 mm nominal) below face of framing.

B. Do not use joints in tape, except at corners; seal joints with compatible sealant

C. After installation of stops, install security sealant over exposed tape on **both** sides of all security glass/polycarbonate provided per this specification section and per 2.5.D.1 above.. This includes but is not limited to doors and windows in the cells, multipurpose rooms, offices, special use rooms, video visitation, and dayroom window walls only within the dayroom area where inmate contact is emanate. The dayroom windows between the dayroom and corridor will require security sealant on the dayroom side only.

1. Security sealant shall be installed as a cap bead only and is never to come in contact with the raw cut edge of the glazing material. Setting blocks shall be installed in a heal bead of glazing sealant equal to Dow Corning 795 per 3.3.D above. If security sealant is found on raw glazing edge during inspection, the DEC shall be responsible for replacing the glass at their expense.

D. Apply fillet bead of Dow Corning 795 glazing sealant over exposed tape on exterior side of exterior glazing..

3.5 PROTECTION AND CLEANING

A. Apply warning tape or bands across opening without touching glazing, immediately after installing glazing in frames.

B. Do not apply tape or labels to glazing; remove temporary labels.

C. Protect glazing during subsequent construction operations; remove dirt, contaminants, staining agents and other deposits promptly using manufacturer's recommended procedures.

D. Replace glazing that is damaged.

E. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that security glazing is without damage or deterioration at the time of Substantial Completion.

F. Remove protective masking paper from polycarbonate glazing just prior to cleaning.

G. Wash both sides of glazing not more than 10 days before inspections for Substantial Completion.

3.6 OWNER PERSONNEL INSTRUCTION

A. Have manufacturers' maintenance instructions on hand at time of instruction.

B. Instruct designated Owner personnel on maintaining security glazing.

END OF SECTION 088853

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Patch and repair damaged flooring substrate where existing wall structures are removed.

1.02 RELATED REQUIREMENTS

A. Section 02 41 19 - Selective Building Remodel Demolition.

B. Section 03 30 00 - Cast-in-Place Concrete: Concrete infill slabs at removed portions for new floor drains.

1.03 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).

1.04 QUALITY ASSURANCE

A. Installation of underlayment shall be by a qualified, factory-trained applicator who has specific experience with the installation of specified underlayment materials.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

PART 2 PRODUCTS

2.01 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

A. Manufacturers:
   1. TEC, an H.B. Fuller Construction Products Brand: www.tecspecialty.com.
   2. ARDEX Engineered Cements: www.ardexamericas.com.
   3. Custom Building Products: www.custombuildingproducts.com.
   4. LATICRETE International, Inc: www.laticrete.com.

2.02 MATERIALS

A. Trowel-Applied Cementitious Skimcoat Patching Underlayment: Blended moisture-resistant, rapid-drying, portland cement-based polymer-modified patching mix, that will be ready to receive carpet flooring when fully cured.
   1. Thickness: Feather edge to 1/2 inch thickness at perimeter of fill.
   2. Basis of Design: ARDEX MRF Moisture-Resistant, Rapid-Drying, Skimcoat Patching Underlayment.

B. Self-Leveling Underlayment: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any

recommendation from flooring manufacturer, provide a product with the following characteristics:

1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
3. Compressive Strength: 5000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
4. Products:
   a. TEC, an H.B. Fuller Construction Products Brand; Level Set 300 Self-Leveling Underlayment: www.tecspecialty.com.

PART 3 EXECUTION

3.01 PRELIMINARY CLEANING

A. Clean floors of dust, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.02 CEMENTITIOUS PATCHING UNDERLAYMENT

A. Where existing concrete floors show damage from removed wall structures, fill and smooth said damaged areas with patching compound.

B. Trowel smooth and flush with top of adjacent floor surface.

3.03 APPLICATION OF SELF-LEVELING UNDERLAYMENT INFILL

A. Where self-leveling underlayment is more appropriate for floor repairs, iInstall self-leveling underlayment in accordance with manufacturer's instructions.

B. Pump or pour material onto substrate. Do not retemper or add water.
   1. Pump, move, and screed while the material is still highly flowable.
   2. Be careful not to create cold joints.
   3. Wear spiked shoes while working in the wet material to avoid leaving marks.

C. Place to required thickness, with top surface level to 1/16 inch in 10 ft.

D. Curing
   1. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
   2. Air cure in accordance with manufacturer's instructions.

3.04 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Metal partition framing.

B. Framing accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 21 00 - Building Insulation: Sound batt insulation.

B. Section 09 29 00 - Gypsum Board.

1.03 SUBMITTALS

A. Shop Drawings:
   1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
   2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.

B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

1.04 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories: Knorr Steel Framing Systems, Dietrich Metal Framing, Consolidated Fabricators, Angeles Metal Systems, Steeler, Grabber Construction Supply Inc., SCAFCO Corp., or approved.

2.02 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).
   1. Studs: C shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C shaped.
   4. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).

B. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and braced with continuous bridging on both sides.

C. Non-Loadbearing Framing Accessories:
   1. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

2. Fasteners: ASTM C1002 self-piercing tapping screws.
3. Anchorage Devices: Powder actuated.
4. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

2.03 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

A. Comply with requirements of ASTM C754.

B. Extend partition framing to structure where indicated and to ceiling in other locations.

C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

D. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

E. Align and secure top and bottom runners at 24 inches (600 mm) on center.

F. Place one bead of acoustic sealant between runners and substrate, studs and adjacent construction.

G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

H. Install studs vertically at 16 inches (400 mm) on center.

I. Align stud web openings horizontally.

J. Secure studs to tracks using fastener method. Do not weld.

K. Stud splicing is not permissible.

L. Fabricate corners using a minimum of three studs.

M. Install double studs at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings.

N. Brace stud framing system rigid.

O. Coordinate erection of studs with requirements of door frames; install supports and attachments.

P. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

Q. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches (150 mm).

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation From Plumb: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Suspended metal ceiling support system for new gypsum board ceilings at holding cells.

B. Expanded metal security mesh.

1.02 RELATED WORK IN OTHER SECTIONS

A. Section 09 29 00 - Gypsum Board.

B. Section 09 51 00 - Acoustical Ceilings.

1.03 QUALITY ASSURANCE

A. Standard Specifications
   1. General: Where "USG" is used herein it shall mean "United States Gypsum Company".
   2. For Gypsum Board Suspended Ceiling Framing: For the installation of suspended steel framing members for gypsum board conform to the American National Standard "Standard Specifications for the Installation of Steel Framing Members to Receive Screw Attached Gypsum Board, ASTM C754", hereinafter called "ASTM C754".

1.04 SUBMITTALS

A. Manufacturer's Data: Furnish manufacturer's literature for support framing materials and accessories.

B. Shop Drawings
   1. Submit shop drawings showing typical details for all work and relationship of work adjacent thereto. Include methods of joining, fastening, and other pertinent information.
   2. Furnish samples for approval of each different member to be used on the work, upon request of the Architect.

1.05 PRODUCT DELIVERY, STORAGE & HANDLING

A. Delivery, Storage & Protection
   1. All materials shall be delivered in original packages, containers, or bundles bearing the brand name and the name of the manufacturer or the supplier for whom the product is manufactured.
   2. All materials shall be kept dry, stored inside the building under roof, or where necessary to store outside, shall be stacked off the ground, properly supported on a level platform and fully protected from the weather.

PART 2 - PRODUCTS

2.01 METAL FRAMING MATERIALS

A. Standard Suspended Ceiling Members & Accessories For Gypsum Board Work
   1. Hanger Wires and Clips: Galvanized steel No. 8 gauge wires for vertical hangers, hung from clips secured to structural members above ceiling, lengths as required for tying to steel runner channels at 48 inches o.c. For seismic bracing wire, furnish of galvanized steel No. 12 gauge wire.
   2. Main Runner Channels: Furnish 1-1/2 inch x 16 gauge cold rolled steel channels weighing 475 lbs. per 1000 lin. ft., galvanized finish.
   3. Compression Struts: Furnish of steel stud sections of size and gauge required for each respective ceiling condition as set forth in Detail 3/A9.7, complete with necessary bolt anchors.

4. Cross Furring Channels: Galvanized steel, 20 gauge, channel hat-shape similar to USG "Metal Furring Channel" with bearing flanges each side, manufactured for screw attachment of plaster base, of IBC approved type.
5. Tie Wire: 16 gauge and/or 18 gauge galvanized, soft annealed steel wire.

B. Expanded Metal Security Mesh
1. Mesh: Furnish security mesh of flattened expanded carbon steel mesh, McNichols "1/2 #18 Flattened 18 ga." expanded metal, or approved, .312" SWO x 1.00" LWO opening sizes, of manufacturer's standard sheet size. Use for attachment to suspended ceiling framing to receive subsequent application of abuse resistant gypsum board.
2. Fasteners for Security Mesh: Self-drilling No. 8 x 1-inch modified truss head.

PART 3 - EXECUTION

3.01 SUSPENDED CEILING FRAMING - INSTALLATION

A. General
1. Work in this Section shall include installation of all suspended ceiling framing and accessories for gypsum board ceiling work specified under Section 09 29 00.
2. Erect ceilings level or to slopes shown, with tolerance not to exceed 1/8 inch in 12 feet.

B. Main Runner Channels & Suspension Wires For Standard Suspension System For Gypsum Board Work
1. Install wires firmly anchored in, or attached to, structure above in manner conforming to ASTM C754.
2. Space channels 4 feet o.c., suspension wires 48 inches maximum o.c.; erect channels level and to proper radiuses, where indicated, with tolerance not to exceed 1/8 inch in 12 feet in any direction. Install seismic bracing wires as shown on Detail 3/A9.7, at spacing as indicated on Detail 6/A9.7
3. At light fixtures or any other openings that interrupt the main runner channels, install additional cross-reinforcing to restore the lateral stability of grillage.

C. Furring Channels For Standard Suspension System For Gypsum Board Work
1. Install metal furring channels at right angles to main runner channels, spaced 16 inches o.c. maximum.
2. Space furring within 6 inches of walls.
3. Provide 1 inch clearance between furring ends and abutting walls and partitions.
4. Attach furring channels to main runner channels with USG furring channel clips installed on alternate sides of main channels.
5. At light fixtures or any other openings that interrupt the furring channels, install additional cross-reinforcing to restore the lateral stability of grillage.
6. Erect ceilings level and to proper slopes, with tolerance not to exceed 1/8 inch in 12 feet.

D. Compression Struts: Install in conformance with suspension system details, secured to main runner channels and ceiling structure above.

E. Expanded Metal Security Mesh: Apply expanded security mesh to suspended ceiling framing at holding cells, applied with long dimension perpendicular to furring channels, secured to framing members not over 8 inches o.c. along each member using screw fasteners specified above. End joints shall be butted and occur over a steel joist or cross furring member. Edge joints shall be butted and wire tied at mid point between support members.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Standard gypsum board for wall and ceiling applications where not otherwise noted to be abuse-resistant or moisture-resistant gypsum board.

B. Abuse-resistant gypsum board for holding cell ceiling applications.

C. Joint treatment and accessories.

1.02 RELATED WORK IN OTHER SECTIONS

A. Section 02 41 19 - Selective Building Remodel Demolition.

B. Section 09 22 16 - Non-Structural Metal Framing.

C. Section 09 22 26 - Metal Suspension Systems.

D. Section 09 91 00 - Paints And Coatings.

1.03 QUALITY ASSURANCE

A. Standard Specifications
   1. For installation and finishing of gypsum board conform to the American Society for Testing Methods Standard ASTM C840, "Standard Specifications for Application and Finishing of Gypsum Board", hereinafter called "ASTM C840", and to the gypsum board manufacturer's standard specifications and recommendations.
   2. In addition, installation and finishing of gypsum board shall conform to the following:
      a. Gypsum Association Publication GA - 201, Gypsum Board For Walls And Ceilings, latest edition.
      b. Gypsum Association Publication GA - 216, Application And Finishing of Gypsum Board, latest edition.
      c. Gypsum Association Publication GA - 600, Fire Resistance Design Manual, latest edition.
      d. Where "USG" is used herein it shall mean "United States Gypsum Company".

1.04 SUBMITTALS

A. Brochures: Furnish in accordance with Section 01 33 00, for all materials used under work of this Section; include descriptive literature and installation instructions the each panel type.

1.05 PRODUCT DELIVERY, STORAGE & HANDLING

A. Delivery, Storage & Protection
   1. Deliver materials protected from inclement weather and other damage.
   2. Store materials in dry, heated room or building at site.
   3. Lay board flat, off floor, protected from damage; lay specialties and accessories on supports off floor, protected from damage.
   4. Protect building floors and adjacent materials from damage due to the work including drippage of joint cements and adhesives.

1.06 JOB CONDITIONS

A. Temperature & Ventilation
   1. Building to be enclosed by other trades, windows glazed, and temporary or permanent exterior doors installed prior to starting work in this Section; no exceptions.

2. Temperature to be maintained at plus 60 degrees F. minimum during and after drywall installation and joint treatment work no exceptions.
3. Provide adequate, properly regulated ventilation.

PART 2 - PRODUCTS

2.01 GYPSUM BOARD MATERIALS

A. Standard Gypsum Board: Furnish USG "Sheetrock Firecode Gypsum Panels" or Geogia-Pacific “ToughRock Fireguard” or National Gypsum “Fire-Shield” panels, or approved, in 4 foot widths, 5/8 inch thickness, long edges tapered and eased, with surface suitable for decoration and conforming to ASTM C1396, Type "X"; U.L. listed.
   1. Use for all wall applications at new metal stud wall framing.

B. Abuse-Resistant Gypsum Board Panels: Furnish USG "Fiberock Brand VHI" or Geogia -Pacific "DensArmor Plus" or National Gypsum "Fire-Shield Type X Hi-Impact Brand 1000" impact resistant panels, or approved, 5/8 inch thickness, 4 foot width, tapered and eased edges.
   1. Use for new interior ceiling applications at holding cells.

C. Miscellaneous Board Accessories
   1. Corner Bead: Furnish galvanized metal corner with tape reinforcement; USG "Flexible Metal Corner Reinforcing Tape" or Beadex “B1 Splay” flexible corner bead, or approved.
   2. Board Edge Trim: Except as otherwise specified below, furnish similar to USG No. 801-B galvanized steel, proper size and type for board thickness and installation conditions, subject to prior approval.

D. Drywall Screws: Self-drilling, self-tapping steel screws similar to those manufactured by USG, or approved, of the following types and lengths for applications specified:
   1. For Single-Layer Attachment to Steel Framing:
      a. 1 inch Type S bugle head for attachment to 22 ga. or lighter framing.
      b. 1 inch Type S-12 bugle head for attachment to 20 ga. or heavier framing.

E. Joint Treatment Materials For All Gypsum Board Panels
   1. Bedding and Reinforcement Cement: ASTM C475 joint compound and of same manufacture as board used or approved by board manufacturer.
   2. Joint Tape: Plain or perforated, ASTM C475 and of same manufacturer as board used or approved by board manufacturer.
   3. Topping Coat Over Joints and Screw Heads: ASTM C475 finishing or topping compound as manufactured or recommended by manufacturer of board used in the work for joint topping work, and as approved.

F. Textured Coating Materials for Application to Level 4 Finish
   1. General: Furnish specifically formulated for application to new gypsum board wall surfaces properly prepared to receive them, compatible with joint materials.

G. Primer-Sealer for All Gypsum Board Panels: One coat Hamilton Drywall Products "Perm Tex" Vapor Barrier Primer, or approved.

PART 3 - EXECUTION

3.01 GYPSUM BOARD INSTALLATION

A. General
   1. Conform to above referenced standards and to UL, IBC and the installation instructions of the respective gypsum board manufacturer used on the work and as supplemented

herein. In addition, conform to all U.L. and IBC requirements where "UL Design" numbers and IBC Table numbers are indicated at wall types.

2. Install abuse resistant panels at ceilings in new holding cells as noted above, installed over expanded metal mesh. Use standard gypsum board panels at all other locations and applications.
3. At walls where shown to have gypsum board extending continuous through ceiling, install wall panels, fire tape and mud above ceiling line prior to installation of ceiling panels; where wall panels are shown to terminate at ceiling line, apply gypsum ceiling board panels on ceilings first.
4. Install board panels perpendicular to supports with end joints over supports, with 1/16 to 1/8 inch space between butted ends of boards.
5. Space fasteners 3/8 inch minimum from ends and edges. Stagger screws on adjoining edges and ends.
6. Bottom edge of all panels shall be 1/4-inch above floor surface and filled with acoustical sealant. Top edge of all panels extending to ceiling structure above shall be terminated 1/4-inch from ceiling surface and filled with acoustical sealant.
7. Use maximum practical lengths to minimize end joints. Stagger joints on opposite faces of wall so that joints occur on different studs.
8. Leave 1/8 inch gap between edge of boards and adjacent CMU wall surfaces, complete with casing beads, for subsequent application of sealant per Section 07 92 00.
9. Fit panels snugly into steel door frames; no joints to occur within 12 inches of the corner of door frames, except at intersecting walls.

B. Gypsum Board Installation - General
   1. For single layer attachment to metal framing at non-rated wall and ceiling assemblies, use appropriate screw fasteners as specified above, spaced as set forth in ASTM C840, Section 8.
   2. Gypsum board shall be installed to within the following tolerances:
      a. Between board faces: 1/16 inch offset.
      b. Plane, level, warp, or bow: 1/8 inch in 10 feet.

3.02 BOARD ACCESSORY INSTALLATION

A. Corner Bead: Install at all exterior corners in finished spaces from 6 inches above ceiling line, of full stock lengths wherever possible, in alignment with wall surfaces, cemented in accordance with manufacturer's instructions. In all cases, gaps in at adjoining board edges, behind corner beads, shall be over-filled completely with taping mud immediately prior to application of bead.

B. Board Edge Trim: Install approved type trim in finished spaces below ceiling line, full stock lengths, at all exposed ends and edges of board and where board abuts dissimilar materials, screwed or screwed and cemented, as applicable, in accordance with manufacturer's instructions.

3.03 TAPING & FINISHING

A. Gypsum Board - General
   1. Tape and finish all joints, corners, fastener heads, imperfections, etc., in accordance with manufacturer's specifications and recommendations and as herein specified.
   2. Finish at gypsum board panels scheduled to receive paint finish shall be finished to a minimum Level 4 finish, ready for application of primer-sealer application as specified below.

B. Taping & Finishing For All Gypsum Board Panels

1. All exposed joints, angles, and inside vertical corners shall be reinforced with tape embedded with joint compound and finished with not less than three applications of topping compound, allowing each application to dry thoroughly and sanding between coats as required.
2. All outside vertical corners shall be finished with not less than three applications of topping compound, allowing each application to dry thoroughly and sanding between coats as required.
3. Taping:
   a. Apply a uniform layer of taping compound to all joints and angles to be reinforced.
   b. Apply reinforcing tape immediately centered over the joint and seated into the compound.
   c. Skim coat shall follow immediately but shall not function as a fill or second coat.
   d. Tape shall be properly folded and embedded in all angles to provide a true angle.
4. Filling: After taping compound has hardened, apply topping compound, filling the board flush with the surface. Fill coat shall cover the tape and feather out slightly beyond the tape.
5. Finishing:
   a. Fastener Depressions: Apply taping compound to all fastener depression followed when hardened by at least two (2) coats of topping compound, leaving all depressions level with plane of the surface.
   b. Apply topping compound to all exposed corners of beads and trim, feathering out from the ground to the plane of the surface as specified for joints.
   c. Finish joints with at least two (2) coats of topping compound, each coat extending beyond preceding coat. Feather joints to 6 inches each side of the joint; feather joints at square edges or butt ends of boards 12 inches each side of the joint.
   d. All coats of joint compound shall be sanded after each application has dried. Exercise care when sanding to avoid roughing the face of panel. For final sanding, use 150 grit or finer sandpaper. Provide a smooth surface with joints fully concealed.
6. The final application of compound and sanding shall leave all gypsum board surfaces uniformly smooth and in proper condition to receive primer-sealer specified herein and other finishes as scheduled.

3.04 PRIMER-SEALER ON EXPOSED BOARD SURFACES

A. Application Of Primer-Sealer On All Gypsum Board Panels

1. Do not proceed with this work until all surfaces, joints, and fastener heads are properly prepared.
2. Apply one coat latex primer-sealer as specified above evenly using roller at an approximate coverage rate as recommended by the manufacturer and to achieve a “smooth wall”, free from surface blemishes, irregularities holidays, sags, etc.; apply coat to a minimum of 350 square feet per gallon. Do not thin material.
3. Use rollers of a type as recommended by the primer manufacturer. Back-roll primer if applied by spray. Apply additional coat to surfaces that have been damaged.

3.05 SPRAYED TEXTURE ON EXPOSED BOARD SURFACES

A. Surface Preparation: Do not proceed with this work until all surfaces, joints, and fastener heads are properly prepared and have received one coat of primer-sealer as specified above.

B. Texture Application
   1. General: Apply texture coating to all new gypsum board wall surfaces.
   2. Priming of Gypsum Board: Gypsum board surfaces shall receive one coat of primer-sealer as specified above.
   3. Texture Application: Machine spray-apply texture in medium to fine 'orange peel' texture to match existing adjacent wall texture, as approved, in manner recommended by texture material manufacturer.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Resilient wall base and associated adhesive.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical information and installation instructions for type of resilient base materials required.

B. Samples: Submit verification samples of type and color of base required.

1.03 PRODUCT DELIVERY, STORAGE & HANDLING

A. Delivery & Storage
   1. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked.
   2. Carefully handle all materials and store in original containers at not less than 65 deg. F. for at least 48 hours before start of installation.

1.04 JOB CONDITIONS

A. General
   1. Store materials in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 65 deg. F. in areas where work in completed.
   2. Install resilient base after other finishing operations have been completed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Resilient Base
   1. Furnish rubber base as manufactured by Mercer, Roppe, Johnsonite, or approved, 4 inches high, 1/8-inch gauge thickness, conforming to dimensional and performance criteria of ASTM F1861, Type TS thermoset vulcanized rubber.
   2. Furnish in continuous roll, color to match color of existing base; non-continuous base shall not be accepted.
   3. Use set-on type with coved bottom (toe base) at all locations.

B. Adhesive: Furnish chemical-set adhesive for base of type recommended by manufacturer of base; emulsion type adhesive not permitted.

PART 3 - EXECUTION

3.01 PREPARATION

A. Condition Of Surfaces: Verify wall surfaces are in proper and smooth condition before proceeding. Installation of base constitutes acceptance of surfaces.

B. Preparation Of Surfaces
   1. Wall substrates to be made free of structural and finish imperfections by other trades before floor covering work proceeds.
   2. Installation of base over improperly finished substrates constitutes acceptance of surface by installer.

3.02 INSTALLATION

A. Resilient Base
   1. Cement directly to backing in accordance with manufacturer's directions.
   2. Install base in continuous lengths, corner to corner, with mitered interior corners. Tightly bond base to backing throughout the length of each piece, with continuous contact at horizontal and vertical surfaces.

B. Finishing
   1. After bases and accessories have set sufficiently, wash with neutral cleaner; include removal of adhesive from base and adjacent surfaces and dirt from adjacent surfaces where caused by work under this Section.
   2. Leave surfaces clean and smooth, free from waves, buckles, projecting edges, and other defects.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. General Description Of Work: In general, work includes surface preparation, priming and finish painting of new gypsum board wall and ceiling surfaces as well as existing gypsum board surfaces damaged or modified by new work. Work also includes surface preparation, priming and finish painting of certain existing CMU wall surfaces and new hollow metal door and frame surfaces.

1.02 RELATED WORK IN OTHER SECTIONS

A. Section 02 41 19 - Selective Building Remodel Demolition.

B. Section 04 20 00 - Unit Masonry.

C. Section 08 11 13 - Non-Detention Hollow Metal Work.

D. Section 08 34 63 - Detention Security Hollow Metal Work.

E. Section 09 29 00 - Gypsum Board.

F. Section 09 96 56 - Epoxy Coatings.

1.03 QUALITY CONTROL

A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

1.04 SUBMITTALS

A. Samples
   1. Before commencing work, prepare samples for each applicable color and substrate; samples may be applied over tempered hardboard substrate. Size for all samples shall be not less than 12" x 12".
   2. Furnish additional required samples until colors, finishes, textures are reviewed and accepted by the Inspection Agency (followed by written authorization to proceed).
   3. Mark on each sample paint manufacturer and coating series, together with color code formula.
   4. Allow ample time for approval of colors; do no work until colors are approved.
   5. Retain approved samples for reference.

B. Materials Lists
   1. Submit, separately for each facility, complete and detailed list of materials proposed for use on the work; no exceptions.
   2. Include manufacturers' names and color code numbers.
   3. Obtain Owner's approval of materials before ordering.

C. Product Data
   1. Submit manufacturer's published literature for specified products and accessories as applicable, including manufacturer's specifications, physical characteristics and performance data, plus material safety data sheets (MSDS) for all products where applicable.
   2. Submit as a supplement, manufacturer's instructions and directions for application if not included in manufacturer's published literature.

1.05 PRODUCT DELIVERY, STORAGE & HANDLING

A. Delivery & Storage Of Material
   1. Deliver materials to jobsite in unbroken sealed packages with manufacturer's original labels thereon, bearing manufacturer's name, type of paint, brand name, color designation and instructions for mixing and/or reducing. Do not open until Inspection Agency inspects and approves.
   2. Store and mix material outside building; store per manufacturer's recommendations and as required by governing Codes and Ordinances.
   3. Take all necessary precautionary measure to prevent fire hazards and spontaneous combustion; place cotton waste, cloths, and other hazardous materials in containers, and daily remove from site.

1.06 JOB CONDITIONS

A. Condition Of Surfaces
   1. Put surfaces in proper condition for application of finishes. Complete all major cleaning of existing surfaces prior to application of paint coatings.
   2. Do no outside work during damp or freezing weather, or until surfaces have thoroughly dried from the effects of such weather.
   3. See that proper temperatures are maintained for inside work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Paint Material Quality
   1. Provide the best quality grade of the various types of coatings as regularly manufactured by approved paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.
   2. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only to recommended limits.
   3. Provide paints of durable and washable quality.

B. Colors & Finishes
   1. Prior to beginning work, the Architect will furnish sample color chips for surfaces to be painted, as selected from full line of color chips furnished by paint manufacturer.
   2. Match the colors of the chips and submit samples, as specified herein, before proceeding with the work. Final acceptance of colors will be from samples applied on the job.
   3. Paint for all walls and ceilings where paint is scheduled shall be equal to Sherwin Williams "ProMar 200 Zero VOC Interior Latex Semi-Gloss” B31W2600 Series no VOC, low odor interior waterborne latex-based paint, or approved, with a gloss level of 20 to 35 units @ 60 deg. and a sheen level of minimum 35 units @ 85 deg.
   4. Colors: Allow for two colors to be selected by Architect in new or remodeled rooms, including ceilings; color in existing open spaces to match existing gypsum board wall color.

2.02 MIXING & THINNING

A. Proprietary Products: Mix and thin only in accordance with manufacturer's printed directions.

PART 3 - EXECUTION

3.01 PREPARATION OF SURFACES

A. Surface Preparation
   1. Before Starting Work Under This Section: Do not proceed until any discovered defects have been corrected and surfaces are approved as ready to receive the work under this Section.
   2. Upon Starting Work:
      a. Conform to Field Quality Control requirements specified hereinafter.
      b. Starting work under this Section constitutes acceptance of surfaces by painter.
      c. Unless otherwise specified, surfaces considered the responsibility of other trades for work under this Section include:
         1) Shop prime coats of miscellaneous metal and other shop prime coated metal items except for minimal spot touch-up painting at field welds and surfaces abraded during their installation.
         2) The condition of substrates to be painted or finished under this Section, which may adversely affect the painting work. If substrate in Contractor's opinion is not up to industry standards, advise Architect.

B. Surface Preparation - All Work
   1. General:
      a. Prepare surfaces to receive scheduled work under this Section as hereinafter set forth.
      b. Before applying paint or other finish, remove or provide ample protection for hardware, accessories, plates, and similar items; remove protection or replace upon completion.
      c. Use only skilled mechanics for removing and reinstalling above items.
   2. For Mildew Removal: Scrub with a non-sudzing biodegradable detergent, bleaching solution, then rinse with potable water and let thoroughly dry.
   3. Miscellaneous Steel, Iron and Sheet Metal: Put in proper condition to receive paint. Grease, rust, scale, dirt and dust are required to be removed by other trades except as otherwise noted. Use only prime paints compatible with finish coats.
      a. Surfaces shop primed by others:
         1) At field welded or abraded spots, apply a phosphoric acid etch solution. Let set as recommended by acid etch manufacturer. Rinse with potable water. When thoroughly dry, immediately apply prime coat.
         2) Clean previously primed surfaces free of any remaining oil and grease.
      b. Surfaces not previously shop primed:
         1) Remove rust and scale by wire brushing, sandblasting, or other approved methods.
         2) Remove rust, dirt, oil and grease. Clean surfaces using solvent wash. Apply phosphoric acid solution. Let set as recommended by acid etch manufacturer. Rinse with potable water. When thoroughly dry, immediately apply prime coat. Any defects showing in prime surface are required to be repaired by other trades. Re-prime over repaired defects.
   4. Gypsum Board:
      a. Surfaces are to be crack-free, properly finished and left clean by other trades.
      b. Remove any minor subsequent contamination, dust and dirt.
      c. If surface defects appear after prime coating, have defects repaired by and at the expense of the drywall trade after defects are corrected, proceed with finish painting again using primer over repaired areas.

C. Additional Surface Preparation Requirements For Existing Surfaces Scheduled Or Required To Be Cleaned &/Or Re-Finished
   1. General:
      a. Coordinate repair work for the various existing finish wall and ceiling surfaces specified herein with work for same specified under other Sections.
      b. On existing finished surfaces to be re-painted or re-finished, remove all loose, blistered, scaled, or crazed finish to bare base material surface.
      c. Wash with a non-sudzing biodegradable detergent or approved cleaning solution as required to remove any accumulated film of wax, oil, grease, smoke or other foreign matter which would impair bond of, or bleed through new finishes; after washing, rinse with clean water and let thoroughly dry.

D. Materials Preparation
   1. Mix and prepare painting materials in accordance with manufacturer's directions. Do not mix together paints of different manufacturers.
   2. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.
   3. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and, if necessary, strain the material before using.

3.02 APPLICATION OF PAINT & FINISH

A. Workmanship, General
   1. Highest quality consistent with trade practice, performed by skilled mechanics.
   2. Apply paint and finish materials by method at painter's option to achieve the best results for matching existing adjacent surfaces; spread material evenly, without runs or sags.
   3. Apply additional coats when undercoats or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.
   4. Cut sharp lines against other materials not to be refinished. Tape adjacent window frames, light fixtures, door hardware, handrails, railings, etc., to prevent paint from said surfaces. Provide cover over window glass as necessary to protect from overspray.
   5. Allow ample time between coats for thorough drying not less than manufacturer's recommended minimum time.
   6. Paint surfaces behind movable equipment the same as similar exposed surfaces.

B. Finish Film Thickness: Apply primer, intermediate, and finish coats to not less than wet and dry film thicknesses and spreading rates as recommended by product manufacturer for each of the various types of specified materials, unless otherwise specified herein.

C. Cleaning
   1. As the work proceeds, and on its completion, promptly remove all spilled, splashed or splattered paint. Remove in such a manner as not to damage surfaces. Thoroughly clean paint and splatters from glass, mirrors, and other such surfaces. Take care not to scratch surfaces.
   2. During progress of work, keep premises free from any unnecessary accumulation of tools, equipment, surplus materials, and debris resulting from the work of this Section. At work's conclusion, leave premises neat and clean.

D. Protection
   1. Protect surrounding areas and surfaces to preclude damage during work of this Section.
   2. Make good any damage caused by failure to provide suitable protection, but not any damage caused by other trades.

3.03 EXTERIOR PAINTING & FINISHING SCHEDULE

A. General: Work specified herein is in ADDITION to shop coats called for under other Sections.

B. New Exterior Hollow Metal Door & Frame
   1. Surfaces to be Painted: Include exterior and interior faces, ends and edges of new exterior hollow metal door and exposed frame surfaces, as applicable.
   2. Field Prime Coat: Apply one (1) coat Sherwin Williams “Pro Industrial Pro-Cryl Universal Primer,” or approved, applied to a 1.9 - 3.8 mils dry film thickness.
   3. Finish Coats: Apply two (2) coats Sherwin Williams “Pro Industrial Waterbased Acrolon 100” water-based urethane, or approved, with high gloss; 1.8 - 3.6 mils dry film thickness each coat.
   4. Finish Color: Match color of existing exterior doors, as approved by Owner.

3.04 INTERIOR PAINTING

A. General
   1. Work specified herein is in ADDITION to shop coats called for under various other Divisions and Sections.
   2. All coats including primer to be shaded differently. All colors specified herein are subject to Architect's review and approval of final color selection.

B. Gypsum Board Wall & Ceiling Surfaces
   1. Primer Coat: In addition to primer coat specified under Section 09 29 00, apply one coat Sherwin Williams "ProMar 200 Zero VOC Interior Latex Primer", or approved.
   2. Finish Coats: Over primer coat apply two (2) coats Sherwin Williams “ProMar 200 Zero VOC Interior Latex Semi-Gloss” B31W2600 Series, or approved, applied to a minimum 1.5 mils DFT each coat.
   3. Finish Colors: As selected by Owner.

C. Concrete Masonry Units
   1. Primer/Block Filler For All New CMU Wall Surfaces: Apply one coat Sherwin Williams "PrepRite Block Filler" Interior/Exterior Latex B25W25, or Devoe Paint “Primz220 Interior/Exterior Latex Block Filler” DV52903 or approved; 10.0-11.0 mils dry film thickness.
   2. Finish Coats: Over primer coat apply two (2) coats Sherwin Williams “ProMar 200 Zero VOC Interior Latex Semi-Gloss” B31W2600 Series, or approved, applied to a minimum 1.5 mils DFT each coat.
   3. Finish Color: Same as selected for gypsum board.

D. New Interior Hollow Metal Door & Frame
   1. Surfaces To Be Painted: Include both faces, ends and edges of new interior hollow metal door and exposed frame surfaces.
   2. Prime Coat: Apply one (1) coat Sherwin Williams “Pro Industrial Pro-Cryl Universal Primer,” or approved, applied to a 1.9 - 3.8 mils dry film thickness.
   3. Finish Coats: Apply two (2) coats Sherwin Williams “Pro Industrial Waterbased Acrolon 100” water-based urethane, or approved, with high gloss; 1.8 - 3.6 mils dry film thickness each coat.
   4. Finish Color: Match color of existing hollow metal doors and frames, as approved by Owner.

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide labor, equipment and materials to complete and finish as specified herein all interior walls and floors at new holding cells, consisting of 100% solids polyamine cured epoxy with fiber reinforcement and an integrated topcoat system.

1.02 RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place Concrete.

B. Section 04 20 00 - Unit Masonry

C. Section 09 05 61 - Common Work Results for Flooring Preparation.

1.03 REFERENCES

A. International Concrete Repair Institute (ICRI) Guide No. 03732, "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays."

B. ASTM D4263-83 (1999), "Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method".

C. ASTM F1869-98, "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride".

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain primary resinous floor and wall materials including hardening agents, finish or sealing coats from a single manufacturer with not less than 5 years of successful experience in manufacturing and installing the principal materials described in this section. Provide secondary materials only of type and from a source recommended by the manufacturer of the primary material.

B. Contractor Experience: Furnish list of projects using materials specified for this project that applicator has furnished during the past five years. Include the following:
   1. Letter of training certification from the manufacturer/distributor stating that contractor is an approved installer of the products specified in this Section.
   2. Submit written description of the contractors experience with the specified material over the last five (5) years.
   3. Submit a list of five (5) projects of similar complexity and size as this project including Owner's names with phone numbers.
   4. Submit resume of the key person(s) who will be performing the actual work and list a minimum of five (5) projects with different Owners giving contact names and phone numbers as references.

C. Sampling of Material:
   1. When directed by Architect, obtain test samples from material stored at the project site or source of supply.
   2. Select samples at random from sealed containers

D. Pre-application Meeting: Convene a pre-application meeting Two (2) weeks before start of application of coating systems. Require attendance of parties directly affecting work of this section, including Contractor, Architect, applicator, and manufacturer's representative. Review the following:
   1. Environmental requirements.

2. Protection of surfaces not scheduled to be coated.
3. Surface preparation.
4. Application.
5. Repair.
6. Field quality control.
7. Cleaning.
8. Protection of coating systems.
9. Coordination with other work.

E. Manufacturer Supervision: A representative of the materials manufacturer shall be present on site for the duration of the preparation and for all phases of the installation of the specified coating materials.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each coating, including generic description, complete technical data, surface preparation, SDS sheets, and application instructions.

B. Samples:
   1. Submit samples of finished product on substrate to be applied:
      a. Prepare samples on each type of material to be covered.
      b. Make samples not less than four (4) inches square.
   2. Color Samples: Submit manufacturer's color samples showing full range of standard colors.

C. Manufacturer's Quality Assurance: Submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.

D. Applicator's Quality Assurance: Submit list of a minimum of 5 completed projects of similar size and complexity to this Work. Include for each project:
   1. Project name and location.
   2. Name of Owner.
   3. Name of Contractor.
   4. Name of Architect.
   5. Name of coating manufacturer.
   6. Approximate area of coatings applied.
   7. Date of completion.

E. Warranty: Submit manufacturer's standard warranty.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
   1. Coating or material name.
   2. Manufacturer.
   3. Color name and number.
   4. Batch or lot number.
   5. Date of manufacture.
   6. Mixing and thinning instructions.

B. Storage:
   1. Store materials in a clean dry area and within temperature range in accordance with manufacturer's instructions.
   2. Keep containers sealed until ready for use.
   3. Do not use materials beyond manufacturer's shelf life limits.

C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.07 JOB CONDITIONS

A. Environmental Requirements:
   1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied. Surfaces to be coated shall be between 65°F and 85°F. Do not apply coating systems at temperatures beyond those limits stated in the manufacturer's technical data sheet unless given written permission by the manufacturer.
   2. Concrete substrates shall be properly cured for a minimum of 30 days.
   3. Do not apply finish in areas where dust is being generated.

B. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with manufacturer's instructions.

C. Dust and Contaminants:
   1. Schedule coating work to avoid excessive dust and airborne contaminants.
   2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

D. Protections: Cover or otherwise protect finished work of other trades and surfaces not being coated concurrently or not to be coated.

1.08 WARRANTY

A. Manufacturer shall furnish a single, written warranty covering 100% of the material and labor costs protecting the Owner from delamination, disbondment, and osmotic/hydrostatic failure for a period of one year from date of installation.
   1. Issuance of warranty shall be a condition contingent on the receipt of final payment to the Installer.
   2. Extent of warranty shall be limited to the repair or replacement of defective surfaces at no cost to the Owner, and for any damage directly resulting from such defects during the warranty period. The warranty shall not include any remedy for defects caused by abuse, improper maintenance or operation, or by normal wear, tear and usage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Tnemec Company Incorporated, 6800 Corporate Drive, Kansas City, Missouri 64120. Tnemec contact: Jenny Senner 206-762-5755 or direct line 206-330-6608. Web Site www.tnemec.com.

B. Prime Coat Corporation, Libertyville, IL. Prime Coat contact: Kurt Schilling 847-972-2146. Web Site www.primecoat.com.

2.02 MATERIALS

A. Epoxy ("EPXY") Coating System: Seamless, integrated system for floors, walls and ceilings consisting of 100% solids accelerated aliphatic amine cured epoxy with chopped strand fiberglass and/or Kevlar® reinforcement, and an integrated topcoat system.:

1. Basis of Design Product:
   a. Option 1: “Series 270 Stranlok” as manufactured by Tnemec Company, Inc. (www.tnemec.com).
   b. Option 2: "Seamless Shower System 5130" as manufactured by Prime Coat Corporation (www.primecoat.com).
2. System Components - Series 270 Stranlok (Option 1):
   a. Blockfiller/Surfacer: Series 215 Surfacing Epoxy, two-component modified polyamine epoxy block filler / surfacer for CMU wall surfaces; 1/32 to 1/8 inch thickness.
   b. Primer: Series 201 Epoxoprime, two-component, penetrating polyamine cured epoxy primer for all ceiling and concrete floor surfaces; 6 to 8 mils DFT.
   c. Intermediate Coat: Series 270 Stranlok, two-component, fiber reinforced, polyamine cured epoxy; 25 to 40 DFT.
   d. Top Coat (Walls & Ceilings) / Intermediate Top Coat (Floors): Series 280 Tneme-Glaze, two-component, polyamine cured epoxy; 6 to 8 mils DFT.
   e. Top Coat (Floors): Series 291 CRU, two-component aliphatic polyester polyurethane with Series 211 Glass Bead Additive for slip-resistant texture; 2.5 to 3.0 mils DFT. Glass bead mesh size as determined by approved sample finish texture selected by Architect.
3. System Components - Seamless Shower System 5130 (Option 2):
   a. Primer All Surfaces:
      1) Resin: 100% solids epoxy. Product PC 100 EPOXYCOAT or PC 630 GELCOAT over CMU surfaces.
      2) Application Method: Spray and backroll to force material into voids.
      3) Minimum Installed Thickness: 6-8 mils for floors and ceilings; 12-16 mils for CMU walls.
      4) Type: Clear.
      5) Number of Coats:
         a) Ceilings and Floors: 1 coat.
         b) Concrete Masonry Unit Walls: 2 coats at 12-16 mils per coat via spray application and back rolled to force material into voids and fill pinholes.
   b. Floor Base Coat:
      1) Resin: 100% solids Bisphenol A epoxy.
      2) Product: PC 100 EPOXYCOAT
      3) Application Method: Broadcast silica.
      4) Minimum Installed Thickness: 40 mils.
      5) Number of Coats: 1.
   c. Body Coat - Floor, Walls and Ceilings:
      1) Resin: 100% solids Kevlar and Fiberglass reinforced epoxy.
      2) Product: PC 201 Fibercoat SV.
      3) Application Method: 45:1 air-powered airless spray w/gravity-fed hopper.
      4) Reinforcement: Chopped strand fiberglass and Kevlar®
      5) Installed thickness: 20-30 mils.
      6) Number of coats: 1. (Note: additional coats may be required to achieve the specified thickness of 20 to 30 mils.)

d. Top Coat - All Surfaces
   1) Resin: 100% solids epoxy.
   2) Application Method: Spray/roller .
   3) Minimum Installed Thickness: 6-8 mils.
   4) Antimicrobial: Mixed into topcoat.
   5) Type: Pigmented.
   6) Wall Finish: Smooth.
   7) Floor Finish: Shall meet ADA requirements. Series 211 Glass Bead Additive shall be added to floor topcoat at Room 161 to achieve slip-resistant texture.

4. Colors: Colors shall be selected by the Architect from manufacturer's standard palette of not less than 16 standard colors. Floors and associated coved base shall a separate color than walls.

2.03 ACCESSORIES

A. Patching and Fill Material: Resinous product of resinous flooring manufacturer as specified above.

B. Joint Sealants: Formulated by resinous flooring manufacturer for type of service and joint condition indicated in each case.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine surfaces scheduled to receive coatings for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work as included in 3.02. PREPARATION OF SURFACES.

B. Verification: Verify that all substrate and environmental conditions are in compliance with requirements discussed during Pre-installation conference.

C. Mandatory Testing of Floor Slabs:
   1. Prior to the installation of flooring, it is mandatory that all surfaces are tested for moisture content, pH, and alkalinity levels that would be detrimental to the adhesion of coating materials. For tests to be accurate, temperatures and humidity levels should be stabilized for a minimum of 72 hours. NOTE: Testing performed by any method in unconditioned spaces will not yield consistent results. Tests below shall be completed in accordance with documented Test Methods:
      a. Plastic Sheet tests per ASTM D 4263
      b. Calcium Chloride Tests per ASTM F 1869
      c. Relative Humidity [in situ] Testing per ASTM F 2170
      d. pH Testing per ASTM F 710
   2. Do not proceed with installation if moisture levels exceed 5% or 3 lbs. per 1,000 sf per 24 hours or if ambient temperature is less than 5°F above dew point unless approved by material manufacturer.

D. Notify Owner's agent immediately upon determination that surfaces scheduled to receive coating are unacceptable for proper adhesion or subsequent performance.

E. Do not proceed with surface preparation or coating application until conditions are suitable.

3.02 PREPARATION OF SURFACES

A. General: Prepare and clean substrates in accordance with manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral pH substrate for resinous floor/wall application.

B. Concrete Masonry Unit: Prior to installation of high performance coatings, CMU walls shall receive a visual inspection by the onsite manufacturer's representative to assure that the substrate is acceptable for coating. The Masonry Contractor is to correct deficiencies.
   1. Mortar joints are struck clean and filled tightly to avoid gaps or holes and provide a neat, uniform appearance in accordance with procedures as outlined under Division 4 - “Masonry”.
   2. Removal of all mortar spatter, protruding mortar edges, and other excessive mortar.
   3. All rough edges shall be ground smooth.
   4. CMU to be cleaned as specified under requirements as specified in Section 04 20 00, Unit Masonry.
   5. All surfaces shall be clean, dry and free of contaminants prior to installing coating system.

C. Concrete & Underlayment Subfloors:
   1. Smooth troweled dense finish concrete, which shall have been properly cured not less than twenty-eight (28) days after placement.
   2. Employ a radio frequency moisture meter to determine that residual un-combined moisture content of concrete slab is less than five (5) percent by weight. Conduct ASTM F 1869 to further record the Moisture Vapor Emission Rate. Do not apply thin-film high performance floor coatings to floor slabs that exceed 5 percent moisture content or 3 pounds per 1,000 square feet per 24 hours unless approved by the material manufacturer.
   3. For thin-film coatings and floors under 1,000 sf or with limited access: Diamond grind to expose concrete matrix and profile concrete floor surfaces to a classification of ICRI CSP2.
   4. For all other floor systems: Shot blast all concrete floor surfaces to a classification of ICRI CSP5. Vacuum clean concrete to remove all dirt, dust, and other loose materials
   5. Where visual inspection of shot blasted surface indicates that oil-based penetration of the surface has occurred, the stained areas shall be treated with a 15% by volume solution of aqueous tri-sodium phosphate (TSP) or other proprietary de-greasing agent. Rinse and dry all floor surfaces scheduled to receive high performance floor system finish prior to commencement of resinous flooring application.
   6. Remove and legally dispose of all debris and contaminants produced by the shot blasting process. Steel media resulting from the shot blasted floor slab surface shall be removed from cracks, slab edges, construction joints, and corners by magnets, magnetic broom, air blast, vacuum, or stiff bristle broom.

3.03 APPLICATION

A. Mock-Up: Prior to application of the specified system, a full mockup of the same will be installed to show a complete finished shower including installing the finished system on walls, ceilings, and floors with cove base detail. If there are any deficiencies in the mockup contractor will correct them and have them approved prior to proceeding with any work. The mockup will be the basis of acceptance for all shower area finishes.

B. General Requirements: Apply components of each resinous coating system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface at the specified thicknesses.
   1. Do not apply initial coating until moisture content of surface is within limitations recommended by coating manufacturer and never install coatings when the substrate

temperature is less than 5 degrees above dew point unless specifically approved, in writing, by the manufacturer.

2. Coordinate application of components to provide optimum adhesion of resinous floor/wall system to substrate and intercoat adhesion.
3. At substrate control, isolation, and expansion joints, provide joint as necessary in resinous flooring in compliance with manufacturer's directions and engineering details for each joint type.
    a. Apply backer rod and elastomeric joint compound into isolation or expansion joints in compliance with manufacturer's directions.

C. Epoxy Coating System Using Series 270 Stranlok System (Option 1):
1. Blockfiller/Surfacer for CMU Walls: Use blockfiller as a parge coat to surface the entire wall, filling the mortar joints and surface voids in the face of the block. The filler shall be mechanically mixed and applied in accordance with manufacturer's instructions. Finish off all methods of application by using a rubber squeegee to smooth and remove excess material. Allow 24 hours cure at 75 deg. F. before topcoating.
2. Primer for Ceiling and Floor Surfaces: All surfaces shall be primed by brush, roller, or spray applied uniformly at a dry film thickness of 6 to 8 mils. The primer shall be mechanically mixed and applied in accordance with manufacturer's instructions, then allowed to cure to "initial set" or until tacky before proceeding with application of system. Maximum recoat time is 16 hours, however, the following intermediate coat works best if applied over tacky primer, (1 to 3 hrs). If primer is not topcoated within 16 hours, the surface shall be mechanically abraded and reprimed.
3. Intermediate Coat: The fiber reinforced intermediate coat shall be mechanically mixed in accordance with instructions and uniformly applied to all primed surfaces by airless spray. Materials shall be applied at a dry film thickness of 25 to 40 mils on all surfaces. The intermediate coat shall be allowed to cure for a minimum of 8 hours, but not longer than 24 hours before application of topcoat. Before topcoating, the surface shall be pole sanded to smooth surface and remove all protruding fibers. If more than 24 hours have elapsed between coats, the Stranlok coated surface must be mechanically abraded before topcoating.
4. Top Coat (Walls & Ceilings) / Intermediate Top Coat (Floors): The high solids epoxy glaze coat shall be mechanically mixed in accordance with manufacturer's instructions applied at a dry film thickness of 6 to 8 mils.
5. Top Coat (Floors): The water based Urethane with slip-resistant additive shall be mechanically mixed in accordance with manufacturer's instructions and applied at a dry film thickness of 4 to 6 mils WFT. The finished floor shall meet ADA specifications for this project. Installer shall provide a Sullmair FSC 2000-1346 Floor tester to validate ADA requirements. Note that achieving the required ADA coefficient of friction may require additional topcoat material or anti-slip additives may be necessary.

D. Epoxy Coating System Using Seamless Shower System 5130 (Option 2):
1. Blockfiller/Surfacer for CMU Walls: The filler shall be mechanically mixed and applied in accordance with manufacturer's instructions in a 2 coat application; each coat 12 to 16 mils thickness. Apply via spray application and back roll to force material into voids and fill pinholes.
2. Trowel-apply cove base and threshold by using a mixture of 100% solids epoxy and aggregates to make mortar system, and allow to set.
3. Mix primer components with a Jiffy Mixer for a minimum of 2 minutes, then apply by roller or spray to floor, wall and ceiling surfaces at 8 mils and allow to tack. Note: When using the membrane no primer is necessary and the membrane is installed at 30 mils minimum.
4. Mix floor Base Coat components with Jiffy Mixer for 2 minutes, pour onto floor in a bead, squeegee apply, backroll. Apply at 20 mils, or 80 square feet per mixed gallon.

5. While Base coat is wet, broadcast silica broadcast sand into base coat to rejection, allow to dry. Sweep off excess after full cure.
6. Mix and spray apply the fiberglass/Kevlar®-reinforced body coat to all floors, walls and ceilings with a 45:1 air-powered airless spray rig with gravity-fed hopper to completely and evenly wrap all surfaces at a thickness of 20-30 mils and allow to cure.
7. Abrade all surfaces to remove any exposed fiberglass and other imperfections, then blend and apply top coat / antimicrobial at 6-8 mils to wall and ceiling surfaces.
8. Mix and apply floor topcoat components with Jiffy Mixer for a minimum of two minutes along with slip-resistant aggregates, then apply by roller at 10 mils, allow to cure.
9. The finished floor shall meet ADA specifications for this project. Installer shall provide a Sullmair FSC 2000-1346 Floor tester to validate ADA requirements. Note that achieving the required ADA coefficient of friction may require additional topcoat material or anti-slip additives may be necessary.

3.04 CURING

A. Cure resinous flooring and wall components according to manufacturer's written instructions. Prevent contamination during curing processes.
   1. Temperatures shall be maintained at 70°F - 80°F if at all possible.
   2. Water leaks must be prevented as they will compromise epoxy components ability to set properly - drips may compromise or stain finishes.
   3. Steam or any airborne contamination will adversely affect curing.

3.05 CLEANING

A. Remove debris promptly from work area and dispose of properly.

B. Remove spilled, splashed, or splattered coating materials from all surfaces.

C. Floor and walls may be cleaned prior to final inspection, providing complete curing has taken place. Generally, non-chlorinated detergents should be used for the first month after curing is complete.

D. Do not mar surface finish of items being cleaned.

3.06 FIELD QUALITY CONTROL

A. Testing Activities During Resinous Flooring Application
   1. Material Sampling: Owner's representative may at any time and any number of times during resinous flooring application require the Owner's independent testing agency to collect material samples for testing for compliance with requirements.
      a. Material samples will be taken, identified, sealed, and certified in presence of Installer.
      b. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures in addition to testing procedures listed in manufacturer's product data.
   2. Adhesion Test: Conduct “pull-off” tests on installed flooring in accordance with ASTM D 4501. Certify to the Engineer/Architect that results conform to the manufacturer's published maximum for adhesive strength before failure.
   3. If test results show applied materials do not comply with specified requirements, Installer shall pay for testing, remove non-complying materials, prepare surfaces coated with unacceptable materials, and reapply location[s] of flooring or wall materials in compliance with requirements.

END OF SECTION

DIVISION 20 GENERAL MECHANICAL

20 02 00 Operation and Maintenance Manual for Mechanical 2
20 05 00 Common Work Results for Mechanical 17
20 05 03 Existing Systems Work for Mechanical 3
20 05 19 Piping Specialties for Mechanical 3
20 05 29 Hangers and Supports for Mechanical 8
20 05 30 Sleeves and Seals for Mechanical 7
20 05 48 Vibration and Seismic Controls for Mechanical 3
20 05 90 Underground Utilities Excavation and Fill for Mechanical 6
20 05 93 Testing, Adjusting, Balancing for Mechanical 6
20 07 00 Mechanical Insulation 7
20 08 00 Commissioning of Mechanical Systems 3

DIVISION 21 FIRE SUPPRESSION

21 10 00 Water-Based Fire Suppression Systems 6

DIVISION 22 PLUMBING

22 11 00 Facility Water Distribution 6
22 13 00 Facility Sanitary Sewerage 4
22 40 00 Plumbing Fixtures 5

DIVISION 23 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

23 09 33 Electric and Electronic Control System for HVAC 6
23 09 93 Sequence of Operation for HVAC Controls 2
23 31 00 HVAC Ducts and Casings 7
23 33 00 Duct Accessories 5
23 34 00 Fans 4
23 37 00 Air Outlets and Inlets 3
23 81 43 Air Source Unitary Heat Pumps 6

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Operation and Maintenance Manual.

1.03 SUBMITTALS

A. General: Comply with Section 20 05 00 and Division 01.

B. Preliminary O&M: Submit preliminary review O&M manual for review.

C. Final O&M: Submit Final O&M manuals per Division 01.

PART 2 PRODUCTS

2.01 GENERAL

A. General Contents: A maintenance manual shall be compiled containing maintenance and operating information and maintenance schedules for all project mechanical systems. See Division 01 for quantities, organization, format, and other requirements; meet additional requirements as specified herein.

B. CD Electronic Copy: Shall contain pdf open format copies of the entire O&M manual. Files shall be bookmarked by section.

2.02 SUBMITTAL DATA AND TECHNICAL O&M DATA

A. Submittal Data: Provide manufacturer’s technical product data, with manufacturer's model number, description of the equipment, equipment capacities, equipment options, electrical power voltage/phase, special features, and accessories. Label equipment and fixtures data with same designation as used on contract documents. This information may consist of the same information as the submittal data (clearly identified and marked to suit each item). This information shall be provided for all items requiring maintenance and for items that may require replacement over a 30 year period or be revised due to an Owner building improvement.

B. Technical O&M Data: Provide for each equipment or item requiring maintenance. Label O&M data to clearly indicate which equipment on the project it applies to (use same designation as used in the Contract Documents). Data to include:
   1. Manufacturer’s operating and maintenance manuals and instructions.
   2. Itemized list of maintenance activities and their scheduled frequency.
   3. Maintenance instructions for each maintenance activity.
   4. Manufacturer’s parts list.
   5. Manufacturer’s recommended lubricants.
   6. Size, quantity and type of filters required (as applicable).
   7. Size, quantity and type each belts unit requires (as applicable).
   8. Size, quantity and type of fuses (as applicable).

C. Sources: Provide names, addresses, and phone numbers for local manufacturer's representative, service companies, and parts sources for mechanical system components.

D. Start-Up Reports: Include copies of all equipment and system start-up reports.

E. Balancing Report: Include a full copy of the balancing report under a dividing tab for the specification section (or building system) where this work is specified. Where balancing is provided by others, obtain from the balancer a copy of the report to insert in the O&M's.

2.03 MAINTENANCE SCHEDULES

A. General: Provide Maintenance schedules with an itemized list of maintenance activities and their scheduled frequency (i.e., weekly, monthly, semi-annually, etc.) for item requiring maintenance.

B. Special Maintenance: List any critical maintenance items or areas requiring special attention.

C. Start-Up/Shut-Down: Provide normal start-up, operating, and shut-down procedures; emergency shut-down procedures; and (where applicable) seasonal shut-down procedures.

PART 3 EXECUTION -- NOT USED

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Division 21 - Fire Suppression.

C. Division 22 - Plumbing Systems.

D. Division 23 - Heating, Ventilation, and Air Conditioning (HVAC) Systems.

1.02 WORK INCLUDED

A. General Mechanical System Requirements.

B. Identification and Labeling.

1.03 DEFINITIONS

A. Abbreviations and Terms: Where not defined elsewhere in the Contract Documents, shall be as defined in RS Means Illustrated Construction Dictionary, Fourth Addition and in the ASHRAE Handbook of Fundamentals, latest edition.

B. "As required" means "as necessary to form a safe, neat, and complete working installation (or product), fulfilling all the requirements of the specifications and drawings and in compliance with all codes."

C. "Concealed" means "hidden from view" as determined when areas are in their final finished condition, from the point of view of a person located in the finished area. Items located in areas above suspended ceilings, in plumbing chases, and in similar areas are considered "concealed." Items located in cabinet spaces (e.g. below sinks) are not considered concealed.

D. "Coordinate" means "to accomplish the work with all others that are involved in the work by: directly discussing the work with them, arranging and participating in special meetings with them to discuss and plan the work being done by each, obtaining and completing any necessary forms and documentation required for the work to proceed, reaching agreement on how parts of the work performed by each trade will be installed relative to each other both in physical location and in time sequence, exchanging all necessary information so as to allow the work to be accomplished with a united effort in accordance with the project requirements".

E. "Finished Areas" means "areas receiving a finish coat of paint on one or more wall surface."

F. “Mechanical”, where applied to the scope of work, includes all project fire suppression systems, plumbing systems, HVAC systems, and controls for these systems and all work covered by specification Divisions 20, 21, 22, and 23. Such work is shown on multiple drawings and is not limited to a particular set of sheets, or sheets prefaced with a particular letter.

G. The term "related documents" (as used at the beginning of each specification section), and the Specification Divisions and Sections listed with it, is only an indication of some of the specification sections which the work of that section may be strongly related to. Since all items of work relate to one another and require full coordination, all specification sections, as listed in the Table of Contents, shall be considered as being "related documents", and shall be considered (by this reference) in the same manner as if they had all been listed under the term "related documents" in each specification section.

H. "Work included" (as used at the beginning of each specification section), and the items listed with it, is only an indication of some of the items specified in that Section and is in no way

limiting the work of that Section. See complete drawings and specifications for all required work.

I. "Verify" means "Contractor shall obtain, by methods independent of the project Architect/Engineer and Owner, the information noted and the information needed to properly perform the work". Where used as "verify existing" the reference is to all existing items related to the work (i.e. piping systems, duct systems, electrical power, controls, structural conditions, space available, building construction type, etc.); the "verify" definition shall include "Confirm by means independent of any existing field labeling and independent of the Architect/ Engineer and Owner what the existing piping (or duct) system contains, sizes, what the flow direction is, what normal pressures/temperatures are, what other systems and areas the piping (or duct) is interconnected to; what the existing control voltages/signal types are by direct measurement; what the existing electrical power voltages and phases are by direct measurement; and additional field verification and coordination to ensure that compatible products are provided, correct connections made, and all work performed to allow for fully functioning systems." "Means independent of existing field labeling" shall include methods such as: the use of exterior pressurized sources to pressurize piping system lines, use of flow tests with dyes, physical tracing of piping and all connections to, electronic detection methods, electronic/electric line tracing, electrical measurements, physical disassembling of system, excavation or uncovering of concealed systems, use of insertion cameras and similar efforts.

J. "Substitution": As applied to equipment means "equipment that is different than the 'Basis of Design' equipment scheduled on the drawings (or otherwise indicated in the contract documents)".

1.04 GENERAL REQUIREMENTS

A. Scope: Furnish all labor, materials, tools, equipment, and services for all mechanical work. This section applies to all Division 20, 21, 22, and 23 specifications and to all project mechanical work. All mechanical equipment and devices furnished or installed under other Divisions of this specification (or by the Owner) which require connection to any mechanical system shall be connected under this division of the Specifications.

B. General: All work shall comply with Division 00, General Conditions, Supplementary Conditions, Division 01, and all other provisions of the Contract Documents.

C. Code:
   1. Compliance: All work shall be done in accordance with all applicable codes and ordinances. Throughout the Project Documents, items are shown or specified in excess of code requirements; in all such cases, the work shall be done so that code requirements are exceeded as indicated. Comply with code accessibility requirements.
   2. Documentation: Maintain documentation of all permits and code inspections for the mechanical work; submit documentation showing systems have satisfactorily passed all AHJ inspections and requirements.
   3. Code Knowledge: Contractor and workers assigned to this project shall be familiar and knowledgeable of all applicable codes and ordinances. Code requirements are typically not repeated in the Contract Documents. By submitting a bid, the Contractor is acknowledging that the Contractor and workers to be utilized on this project have such knowledge.
   4. Proof of Code Compliance: Prior to final completion, satisfactory evidence shall be furnished to show that all work has been installed in accordance with all codes and that all inspections required have been successfully passed. Satisfactory evidence includes signed inspections by the local code authority, test lab results, qualified and witnessed field tests, and related acceptance certificates by local code authorities, and field notes by the Contractor as to when all inspections and tests occurred.

D. Complete Systems: Furnish and install all materials, appurtenances, devices, and miscellaneous items not specifically mentioned herein or noted on the drawings, but which are necessary to make a complete working installation of all mechanical systems. Not all accessories or devices are shown or specified that are necessary to form complete and functional systems.

E. Review and Coordination:
   1. General: To eliminate all possible errors and interferences, thoroughly examine all the Drawings and Specifications before work is started, and consult and coordinate with each of the various trades regarding the work. Such coordination shall begin prior to any work starting, and continue throughout the project.
   2. Suppliers: Suppliers of products shall review the documents to confirm that their products are suitable for the application and that all manufacturers requirements and recommendations have been satisfactorily addressed in the Contract Documents. Where not addressed the supplier shall notify bidders and the Engineer prior to bidding to resolve any issue or include in their bid an adequate amount to resolve the issue.

F. Conflicts and Discrepancies: Notify the Architect/Engineer of any discrepancies or conflicts before proceeding with any work or the purchasing of any materials for the area(s) of conflict until requesting and obtaining written instructions from the Architect/Engineer on how to proceed. Where conflicts occur, the most expensive and stringent requirement (as judged by the Architect/Engineer) shall prevail. Any work done after discovery of such discrepancies or conflicts and prior to obtaining the Architect/Engineer's instructions on how to proceed shall be done at the Contractor's expense.

G. Drawings and Specifications: Drawings and specifications are complementary and what is called for in either is binding as if called for in both. The drawings are diagrammatic and show the general arrangement of the construction and therefore do not show all offsets, fittings and accessories which are required to form a complete and operating installation. Mechanical work is shown on multiple drawings and is not limited to a particular set of sheets, or sheets prefaced with a particular letter.

H. Offsets/Fittings:
   1. Piping Systems: Include in bid all necessary fittings and offset to completely connect up all systems, maintain clear access paths to equipment, and comply with all project requirements. Offsets are required to route piping around building structural elements, roof slopes, mechanical systems, electrical systems, and numerous other items. Due to the schematic nature of the plans such offsets are typically not shown. Contractor is responsible to determine the quantity of offsets and fittings required, and the labor involved. No added payment or “extras” will be granted for the Contractor’s failure to correctly estimate the number of offsets and fittings and labor required. Contractor is advised that equipment and fixture connections may require more than 20 elbows per plumbing fixture and coil per pipe line.
   2. Duct Systems: Include in bid all necessary fittings, offsets, and transitions to completely connect all systems, maintain clear access paths, and comply with all project requirements. Offsets are required to route piping around building structural elements, roof slopes, mechanical systems, electrical systems, and numerous other items. Due to the schematic nature of the plans such offsets are typically not shown. Contractor is responsible to determine the quantity of offsets and fittings required, and the labor involved. No added payments or “extras” will be granted for the Contractor’s failure to correctly estimate number of offsets, fittings, transitions and labor required. Contractor is advised that transitions are required at connections to all equipment, to all air inlets/outlets, crossing of beam lines, at crossing with piping, and similar locations.

I. Design: The level of design presented in the documents represents the extent of the design being furnished to the Contractor; any additional design needed shall be provided by the

Contractor. All design by the Contractor shall be performed by individuals skilled and experienced in such work, and where required by local code (or elsewhere in the documents) shall be performed by engineers licensed in the State where the project is located. Include in bid the costs of all such project design; including engineering, drafting, coordination, and all related activities and work. Such designs services are required for many building systems; including but not limited to ductwork at equipment, piping at fixtures and equipment, hanger/support systems, temporary duct/piping systems, mechanical offsets/adjustments to suit other system, and for methods/means of accomplishing the work.

J. Special Tools: Furnish to the Owner one complete set of any and all special tools such as odd size wrenches, keys, etc. (allen wrenches are considered odd), which are necessary to gain access to, service, or adjust any piece of equipment installed under this contract. Each tool shall be marked or tagged to identify its use. Submit a written record listing the special tools provided, date, and signed by the Owner's representative receiving the tools.

K. Standards and References: Shall be latest edition unless a specific edition, year, or version is cited, or is enforced by the AHJ.

L. Warranties:
   1. General: Products and workmanship shall be warranted to be free from all defects, capable of providing satisfactory system operation, and conforming to the requirements of the Contract Documents. Include in the project bid all costs associated with project warranties to ensure that the warranty extends for the required period; possible project delays and failure by others to complete their work may cause the start of the warranty period to be delayed. The Contractor shall be responsible for increasing the warranty dates by corresponding amounts to provide the required warranty periods.
   2. Basic Project Warranty: As described in the General Conditions, Supplementary Conditions, and Division 01. See individual specification sections for specific warranty requirements. Start date and duration are as indicated in General Conditions, Supplementary Conditions, and Division 01. Where not indicated otherwise, the basic project warranty shall start at project substantial completion and be for one year.
   3. Special Warranties: See individual specification sections for special warranty requirements and extended warranty periods beyond the basic project warranty.

M. Permits and Fees:
   1. Obtain and pay for all permits, licenses, fees and inspections as required by the Code and as specified herein (unless noted otherwise).
   2. Pay all charges made by any utility company or municipality for material, labor or services incident to the connection of service (unless noted otherwise).

1.05 SUBSTITUTIONS

A. General: See Division 00 and 01 for information and requirements regarding substitutions. Manufacturers not scheduled on the plans or listed as “Acceptable Manufacturers” require prior approval and shall submit a substitution request form (see Division 01 for requirements and limitations). See Paragraph 2.01 this specification section regarding “Acceptable Manufacturers”.

B. Redesign:
   1. The Contract Documents show design configurations based on particular manufacturers. Use of other manufacturers' products (i.e. substitutions) from what is shown (or specified) may require redesign of mechanical, plumbing, controls, fire protection, electrical, structural, and general building construction to accommodate the substitution.
   2. Review the installation requirements for substitutions and provide redesign of all affected construction. The redesign shall be equal or superior in all respects to the Architect/Engineer's design (as judged by the Architect/Engineer), including such aspects

as equipment access, ease of maintenance, utility connection locations, unit electrical requirements, noise considerations, unit performance, and similar concerns.

3. Redesign shall be done by the Contractor and shall meet the requirements and have the approval of the Architect/Engineer prior to beginning work. Apply for and obtain all permits and regulatory approvals.

C. Construction Modifications: Provide all required construction modifications to accommodate the substituted products; this includes all mechanical, plumbing, controls, fire protection, electrical, structural, and general building construction. Construction modification shall comply with code, specifications, and be equal to designed construction.

D. Costs: Cost of redesign, construction costs, and all additional costs incurred to accommodate substituted equipment shall be borne by the Contractor.

E. Submittals: In addition to other required submittals, submit shop drawings showing the redesign for substituted equipment; submittal shall include installation plans and sections, connecting services (i.e. ducts, piping, electrical) locations and routing, required service clearances, and related installation details. Submit data required by other disciplines to allow review of the impact of the substitution (i.e. weights, electrical).

1.06 QUALITY ASSURANCE

A. Experience: All work shall be performed by individuals experienced and knowledgeable in the work they are performing, and experienced with the same type of systems and building type as this project. By virtue of submitting a bid, the Contractor is acknowledging that workers to be utilized on this project have such experience and knowledge. Upon request of the Engineer, submit resumes showing the work history, training, and types of projects worked on, for individuals assigned to this project.

B. Code: Utilize workers experienced and knowledgeable with codes pertaining to their work; verify code compliance through-out the project.

C. ASME: All pressure vessels, pressure vessel safety devices, and pressure vessel appurtenances shall comply with the standards of, and bear the stamp of ASME.

D. Quality Assurance Checks: Prior to ordering products and making submittals, confirm the following for each:

1. General: Product is suitable for the intended purpose and complies with the Contract Documents.
2. Manufacturer: Product's manufacturer is listed as an acceptable manufacturer in the Contract Document’s or a substitution request (where allowed) has been submitted and the manufacturer has been listed as acceptable.
3. Electrical (for products requiring electrical power):
    a. Product is for use with the voltage/phase as indicated on the electrical plans (or for the electrical circuit the item will be connected to).
    b. Product's ampacity requirements (MCA) do not exceed that indicated on the electrical plans (or for the electrical circuit the item will be connected to).
    c. Where product is a replacement for an existing product, and is to be re-connected to an existing circuit, the existing voltage/phase has been field verified and product matches voltage/phase available.
4. Weight: Product's weight is no greater than that indicated.
5. Space Verification: Product will fit in the space available, and along the path available to install the item, will have adequate service clearances, and will not impede on any clearances required for other items in the space the item will be located.

6. Installation: A suitable method for installing the product has been selected which meets the project schedule and other requirements.
7. Lead Time: The product's fabrication, shipping, and delivery period meets the project schedule requirements.
8. Substituted Equipment: Where equipment is not the basis of design confirm all requirements for substituted equipment have been met and shop drawings of construction revisions have been (or are being) prepared.
9. Controls: Item is compatible with the controls it will be connected to and has been coordinated with the firm providing the project control work.
10. Listing: Item is Listed when required to be as such. And if the item is to be installed as part of a Listed system or assembly, it is compliant with the Listing of the overall system or assembly.
11. Existing Buildings/Systems: Product size, weight, connecting services (i.e. electrical, controls, power, plumbing, etc.) are configured and suitable for existing items they connect to or interface with.

E. Check-Out: The Contractor shall be responsible to verify that proper installation and proper connections have been provided for all mechanical work. Contractor shall provide installation checkout, start-up services, and perform a thorough check of all mechanical systems to verify proper installation and operation. Contractor shall operate all items multiple times under varying conditions to confirm proper operation. Contractor shall submit a checklist listing all equipment, fixtures, and similar items furnished on this project, with a date and initials indicating when the item was checked, a list of what was checked, and by whom. Such check shall, as a minimum utilize documents provided by the equipment manufacturer. Such a check-out is in addition to any commissioning activities specified (unless noted otherwise).

1.07 SUBMITTALS - GENERAL

A. Variations: Only variations that are specifically identified as described herein will be considered. Provide with the submittal (in addition to other information required): description of the proposed variation, entity who is proposing the variation, why the variation is being proposed, any cost changes associated with the variation, and any other pertinent data to allow for review. Failure to submit information on the variation as described will result in the submittal review being conducted without considering the variation.

B. Quality Assurance: By submitting an item for review, the Contractor is claiming that all “Quality Assurance Checks” (see paragraph 1.06 this specification Section) have been performed and satisfactorily passed and no further comment from the submittal reviewer is required for the “Quality Assurance Checks”.

C. Product Submittals - Information Required:
1. Manufacturer's catalog information, containing product description, model number, and illustrations. Mark clearly to identify pertinent information and exact model and configuration being submitted.
2. List of accessories and options provided with product.
3. Product dimensions and clearances required.
4. Product weight.
5. Submittal identified with product name and symbol (as shown on the drawings or written in the specifications) and specification Section and paragraph reference.
6. Performance capacity and characteristics showing compliance with the Contract Documents.
7. Manufacturer's and local manufacturer's representative names, addresses, and phone numbers.
8. For equipment requiring piping or duct connections:

a. Type of connections required.
b. Size and locations of connections.

9. For electrically operated equipment:
   a. Number and locations of electrical service connections required.
   b. Voltage required.
   c. Fuse or circuit breaker protection requirements.
   d. Motor starter requirements; if motor starter is furnished with the equipment, submit product information on motor starter.
10. For equipment requiring control connections:
    a. Type of control signals required.
    b. Control communication protocol.
    c. Information on control devices furnished with equipment.
    d. Location of control connections.
11. Manufacturer's installation instructions.
12. See each specification Section for additional submittal requirements.

D. Shop Drawing Submittals: Provide for the following systems:
   1. Fire Suppression Systems.
   2. HVAC control systems.
   3. For any parts of any system which are to be installed differently than as shown on the drawings.
   4. Construction revisions to accommodate Substituted Equipment.
   5. Other areas/work as noted in the Contract Documents.
   6. For those systems requiring shop drawings, reference system's specification Section for additional requirements.

1.08 RECORD DOCUMENTS

A. Field Record Drawings: Maintain a set of full size contract plans at the project site upon which all changes from the as-bid plans are noted. Plans shall be maintained clean, dry and legible; with information recorded concurrent with construction progress. These plans shall also include actual locations (with dimensions) of all underground and concealed mechanical systems. Connection points to outside utilities shall be located by field measurements and so noted on these record drawings. All addenda, change order, field orders, design clarifications, request for information, and all other clarifications and revisions to the plans shall also be made a part of these record drawings. Plans shall be available for weekly review by the Architect/Engineer. Label drawing “As-Builts” with date, name of Contractor, and name of individual overseeing the work.

B. Final Field Record Drawings Submittal: Deliver to the Architect/Engineer the original Field Record drawings and one full size copy.

1.09 PRODUCT HANDLING, PROTECTION AND MAINTENANCE

A. Protection:
   1. Protect all products from contamination, becoming unclean, and from damage of any kind and whatever cause; when being handled, in storage, and while installed, until final project acceptance.
   2. Completely cover fixtures, motors, control panels, equipment, and similar items to protect from becoming unclean and damage of any kind.
   3. Protect premises and work of other trades from damage due to Mechanical work.

B. Openings: Cap all openings in pipe, ductwork and equipment to protect against entry of foreign matter until all work that could cause unclean conditions or damage is complete (including work that has dust or fumes associated with it). Caps shall be of sufficient strength and seal integrity to prevent entry of water or fumes for the most extreme conditions they may be exposed to (i.e. high velocity water spray, high winds, concrete splash, etc.)

C. Storage: Provide properly conditioned and sheltered storage facilities for products to prevent damage of any kind and to maintain new condition. Provide adequate venting arrangements to avoid condensation damage.

D. Operation and Maintenance:
   1. General: Inspect products periodically to confirm conditions and maintenance needs. Keep records of inspections and (upon request) forward to the Architect/Engineer prior to project final acceptance. Operation and Maintenance shall be in accordance with manufacturer's written procedures and recognized best maintenance practices. Keep records of maintenance and (upon request) forward to the Architect/Engineer prior to project final acceptance.
   2. Stored Products: Provide maintenance (i.e. equipment rotation, lubrication, flush, cleaning, etc.) and inspection on products while stored to maintain new condition.
   3. Installed Products: Provide maintenance and inspection of products and operate mechanical systems until substantial completion or specified Owner Instruction has been provided (whichever is later). Maintenance shall include all labor and materials and all manufacturers' recommended maintenance (i.e. strainer cleaning, filter changes, bearing lubrication, belt tensioning, etc.). In addition to scheduled maintenance, review all equipment periodically to allow detection of improper operation or any special maintenance needs; review shall be consistent with best practices for the product but in no case less than a site visit every two weeks. Document all maintenance activities.

E. Damaged Products: Damaged products shall be replaced with new. Where damage is limited to paint (or similar finish), the product may remain if the finish is restored to a new condition (as judged by the Architect/Engineer).

1.10 JOB CONDITIONS

A. Special Requirements:
   1. Maintain emergency and service entrance usable to pedestrian and vehicle traffic at all times. Where trenches are cut, provide adequate bridging for traffic.
   2. Coordinate startup and shutdown of all mechanical systems and utilities with related trades and the Owner's representative.
   3. Coordinate all construction activities with the Owner's Representative and cooperate fully so as to minimize conflicts and to facilitate Owner usage of the premises during construction.
   4. Provide temporary services to occupied areas to accommodate Owner's use during construction. All temporary work shall comply with same specifications as for new work and be of same quality.

B. Downtime Restrictions:
   1. Contractor shall notify the Owner at least 72 hours in advance of any intended shut-down of any building services or systems and obtain Owner approval prior to proceeding.
   2. Electrical power to the building shall not be interrupted at any one time for more than 15 minutes.

C. Schedule of Work: Arrange work to comply with schedule of construction, and so as not to violate any downtime restrictions, and to accommodate the Owner's scheduled use of the premises during construction.

1.11 ENGINEER FIELD REVIEWS AND TEST WITNESSING

A. General: Arrange construction schedule and notifications to the Engineer to accommodate Engineer's schedule and the possibility of review times occurring up to 14 days after notification, and for the possible failure to satisfactorily pass Engineer's reviews requiring revisions and re-reviews.

B. Notification: Notify Engineer at least 7 days in advance of readiness for reviews; arrange mutually agreed upon times for the reviews to occur.

C. Access: Provide ladders, any special tools and safety equipment to allow Engineer's access to areas and equipment. Remove and reinstall ceiling tiles, access panels, and similar items where requested to allow for reviews.

D. Review of Systems with Equipment:
   1. Prior to Engineer's review, system's equipment shall have received specified start-up and be substantiated by a written report.
   2. Prior to Engineer's review, systems shall have been operating properly for at least five consecutive days prior to the scheduled review date.
   3. Personnel shall be present to operate the system's equipment and controls, and to vary system settings as directed by the Engineer to allow for a review of operation over a range of settings.

E. Re-Review Fees: The project budget allows for one review by the Engineer for specified reviews and witnessing. See Division 00 and 01 for compensation to the Engineer for required re-reviews.

1.12 REFERENCES

A. ASME A13.1: Scheme for the Identification of Piping Systems.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. General: Any reference in the Specifications or on the Drawings to any article, device, product, material, fixture, form or type of construction by manufacturer, name, make, model number, or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The manufacturers listed as Acceptable Manufacturers may bid the project for the items indicated without submitting a substitution request; however, that does not relieve the products from having to comply with the Contract Documents.

B. Substitutions: Products by manufacturers listed as "Acceptable Manufacturers" (other than those listed as the "Basis of Design") are considered substitutions and shall comply with the requirements for substitutions. See Paragraph titled "Substitutions" in Part 1 of this specification section.

C. Considerations: In reviewing a manufacturer for acceptance, factors considered (as compared to the specified item) include: engineering data showing item's capacity, performance, proper local representation of manufacturer, likelihood of manufacturer's future local support of product, service availability, previous installations, previous use by Owner/Engineer/Architect, product quality, availability/quality of maintenance and operation data, electrical requirements, capacity/performance, acoustics, physical dimensions, weight, items geometry and access requirements, utility needs, and similar concerns.

D. Limitations of the Term "Acceptable Manufacturer": The listing of a manufacturer as an Acceptable Manufacturer does not necessarily mean that the products of that manufacturer are equal to those specified. The listing is only an indication of those manufacturers which have

represented themselves as being capable of manufacturing, or have in the past manufactured, items equal to those specified. The burden to review products to confirm equivalency with the specified products is on the Contractor. The Architect/Engineer shall be the final judge as to whether an item is equal to that specified.

E. Quality: Products provided by Acceptable Manufacturers shall be equal to or superior to the specified manufacturer's item in function, appearance, and quality, and shall fulfill all requirements of the Contract Documents. The Architect/Engineer shall be the judge as to whether an item meets these requirements or not.

F. Manufacturer: To be considered as being made by a particular manufacturer, the product must be made directly by the manufacturer and have the manufacturer's name (or nameplate with name) affixed to the product (or on the product container where direct labeling is not possible). Example: manufacture "A" is listed as an acceptable manufacture; manufacturer "B" is not listed as an acceptable manufacturer; manufacturer "A" owns "B"; products from "B" do not qualify as being made by an acceptable manufacturer by virtue of ownership.

2.02 PRODUCTS - GENERAL

A. Standard Products: Products shall be standard products of a manufacturer regularly engaged in the manufacture of such products. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two year use shall include applications of equipment and materials under similar circumstances and of similar size. The two year's experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Except that equipment changes made solely to satisfy code requirements, to improve unit efficiency, or to comply with unique project requirements are not required to have two year prior operation.

B. Latest Design: Products shall be the latest design and version available from the manufacturer, including software. Discontinued products shall not be used.

C. Service Support: Qualified permanent service organizations for support of the equipment shall be located reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

D. Manufacturer's Nameplate: Equipment shall have a manufacturer's nameplate bearing the manufacturer's name, address, model number, serial number, and additional information as required by code. Nameplate shall be securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable. Nameplate shall be of durable construction, easily read, with lettering minimum size 12 font.

E. Compatibility: All components and materials used shall be compatible to the conditions and materials the items will be exposed to. All items exposed to the weather shall be galvanized, or be of stainless steel or similar corrosion resistant material.

F. Sizes: Sizes indicated for products manufactured to standardized sizes (e.g. pipe, pipe fittings, valves, material gauges, etc.) are minimums. During bidding confirm that the sizes are available and meet project requirements. Where indicated sizes are not available provide the next larger available size; confirm this larger size will suit the construction and meet Contract Document requirements prior to ordering. Such size revisions are subject to Engineer's review; indicate size revisions on the product submittal and why the size is being revised.

G. Non-Specified Items: Materials shown on the drawings but not specified shall be provided as shown and as required to suit the application illustrated and intended and shall be of commercial quality, consistent with the quality of similar type items provided on the project. Not all items shown on the drawings necessarily have a corresponding specification; such items

shall be provided per this paragraph and so as to provide complete, finished, fully functioning mechanical systems.

H. Weights: Do not exceed the weights shown unless added structural supports are provided. Such supports shall meet the requirements of the project Structural Engineer. The Contractor shall bear all costs for all redesign and added supports to accommodate heavier equipment. The Contractor shall reimburse the Engineer for all time associated with all review and analyses regarding the use of equipment heavier than that indicated.

I. Temperature/Pressure Rating: All materials and components furnished shall be suitable for the temperature and pressures they will be exposed to. Contractor shall consider possible operating modes to ensure proper material ratings.

J. Standardization: All products of the same type shall be by the same manufacturer and have the same characteristics and features to allow for Owner's standardization.

K. Model Numbers: Any reference to a manufacturer's "model number" is a reference to a manufacturer's series number or type of product, and is not a complete "model number" in having all the necessary numbers/letters to convey all of the features, accessories, and options that are required. These series numbers are only meant to convey a type of product that may meet the project requirements. Where conflicts or discrepancies occur regarding a listed manufacturer's series or "model" number and specified capacities or features, the more stringent and expensive shall prevail.

2.03 ELECTRICAL

A. General: All electrical devices, wiring, products, and work shall comply with the Division 26 specifications and code. See drawings for building occupancy type, types of construction, and areas which may require special wiring methods or other electrical work.

B. Equipment: All equipment requiring power shall be factory wired to an equipment mounted junction box (or an accessible compartment with power terminals or electrical device) arranged to allow for connection of electrical power.

C. Overcurrent protection: Circuit breakers, circuit breaker disconnects, fuses, and other current limiting devices indicated to be provided, shall be rated to suit the maximum overcurrent rating of the item served, and have other ratings, as required by code. Circuit breakers for HVAC and refrigeration unit equipment shall be UL listed by HACR type.

D. Short Circuit Current Rating (SCCR): All equipment (or components) requiring the use of electrical power shall have a SCCR value to comply with code. The minimum rating shall be 65,000 Amps RMS Symmetrical unless a lower value is indicated on the plans or allowed by code. Where the Contractor wishes to utilize equipment having a lower rating, the Contractor shall be responsible to provide calculations substantiating that a lower SCCR is acceptable (and complies with code), or make revisions to the electrical system to accommodate the proposed equipment (or components).

E. Product Certification (Listing): Products which require connection to electrical power shall be certified (i.e. listed) by a Nationally Recognized Testing Laboratory (NRTL) and be labeled (in a conspicuous place) with such certification (or certification mark). Certification shall comply with code, OSHA Standards, and Authority Having Jurisdiction (AHJ) requirements. NRTL's shall be recognized as such by OSHA and the AHJ. Certification shall be for the complete assembly (approval of individual components is not acceptable). Field evaluations to obtain certification shall be performed by accredited product testing laboratories acceptable to the AHJ and Engineer, be performed in accordance with code, NFPA 791, recognized practices, and be labeled to identify the certification. Certification is not required where the AHJ does not require it.

2.04 IDENTIFICATION AND LABELS

A. General: All piping, valves, and mechanical equipment shall be labeled. Labels in concealed accessible spaces shall be reviewed and verified by Architect/Engineer prior to being concealed.

B. Piping:

1. Type: Self-sticking colored identification markers, lettered to identify the pipe contents, and banded at each end with arrow tape indicating the direction of flow. Markers shall be similar and equal to Brady "System 1" and Seton "Opti-Code" markers. Spray painted stencil labeling is not acceptable. Some labels may be special order.
2. Identification Colors: Comply with ASME A13.1, and as follows:

Conveyed Material/System	Background	Letters
Potable Water	Green	White
Refrigeration	Black	White

3. Lettering: Lettering shall identify the material conveyed in each pipe and shall match the designation used on the plans, but without abbreviations. Systems which have supply and return piping shall have piping labeled as such (i.e. heating water return, heating water supply, etc.). Systems that have different pressures shall be labeled to indicate such (i.e. Steam-Low Pressure, Steam- Medium Pressure, Natural Gas-Low Pressure, Natural Gas-Medium Pressure, etc.).
4. Size: Size of letters and color field shall comply with ASME A13.1, repeated here for convenience:

Outside Diameter of Pipe or Covering	Length of Color Field	Size of Letters
3/4 to 1-1/4 Inches	8 Inches	1/2 Inches
1-1/2 to 2 Inches	8 Inches	3/4 Inches
2-1/2 to 6 Inches	12 Inches	1-1/4 Inches
8 to 10 Inches	24 Inches	2-1/2 Inches
Over 10 Inches	32 Inches	3-1/2 Inches

5. Applications: Install on all exposed piping adjacent to each shut-off valve, at branches to indicate changes of direction, where pipes pass through walls and floors, on 20 foot centers or at least one in each room on each pipe. Markers shall be installed on all concealed accessible piping (i.e., piping above suspended ceilings, behind access doors, in accessible chases, etc.) near the point of access. For piping above suspended ceilings, markers shall be installed the same as if the piping was exposed (i.e., same as if the suspended ceiling was not in place). Markers shall be installed so as to be easily read by a person standing on the floor. Provide additional flow arrows at each pipe connection at valves having more than 2 ports (i.e. 3-way control valves).
6. Other Requirements: See other specification Sections for additional requirements.

C. Valves:

1. Labels: Laminated plastic or phenolic material, at least 1/16-inch thick, with black surface layer and white (unless other color indicated) sub-layer for letter engraving to expose sub-layer. Labels shall not be less than 3" x 1" in size. Label shall be pre-drilled at one end for attachment to valve. Attach to valve with No. 6 polished nickel-steel jack chain of sufficient length to allow label to hang free.
2. Lettering: Engrave label with valve size, name of system served (cold water, heating water supply, chilled water supply, etc.) and purpose of valve. Lettering size 3/16-inch, except where needed to be smaller to fit label size.
3. Application: Labels shall be installed on all valves except valves at equipment where the valve purpose is readily obvious.

D. Equipment:

1. Labels: Laminated plastic (or phenolic) material, 1/16-inch thick, with black surface layer and white (unless other color indicated) sub-layer, with engraving through to expose white sub-layer. Minimum 2-inch high (unless indicated otherwise or required due to equipment size) with length to contain required lettering. Label shall be pre-drilled and be mechanically fastened to the equipment. Prior to making labels, submit a list of all proposed labels.
2. Lettering: All caps, engraved on label, with equipment designation (same designation as used on Contract Drawings; e.g. HVAC-101, EF-22, CP-1A). Air handling equipment (i.e. VAV terminal units, fans, etc.) labels shall include the room names and numbers or area of building served (use final installed room designations). Where systems serve portions of the building (i.e. wings or floors), include on label the area served. Lettering shall be in multiple rows, with equipment label on top row. Equipment lettering to be 5/8-inch high; area served lettering to be 3/8-inch high (except that smaller lettering may be used if necessary to fit label size).
3. Application: All scheduled mechanical equipment shall be labeled. The label shall be located on a side of the equipment so as to be easily read, with the marking visible to a person standing at the access level near the equipment (assuming any necessary access to a concealed unit has been made).

E. Electrical Devices:
1. Labels: Minimum 1/4-inch high (unless indicated otherwise) lettering, all caps, engraved on laminated plastic or phenolic material, at least 1/16-inch thick. Laminated plastic (or phenolic) shall have black surface layer and white (unless other color indicated) sub-layer, with engraving through to expose white sub-layer. Label shall be pre-drilled and be mechanically fastened to the item; where mechanical fastening is not possible use 3M VHB double sided specialty tape No. 4945. Prior to making labels, submit a list of all proposed labels.
2. Lettering: Label shall identify the item served (using the same designation as indicated on the Contract Drawings), the source of power (by panel and circuit breaker), and comply with code.
3. Application: Variable frequency drives, motor starters, disconnects, contactors, relays and similar items which control power to equipment and system components shall be labeled. The label shall be located so as to be easily read. See Section 23 09 33 for labeling of low voltage control components.

PART 3 EXECUTION

3.01 GENERAL

A. Workmanship: Furnish and install products to provide complete and functioning systems with a neat and finished appearance. If, in the judgment of the Architect/Engineer, any portion of the work has not been installed in accordance with the Contract Documents and in a neat workmanlike manner, or has been left in a rough, unfinished manner, the Contractor shall be required to revise the work so that it complies with the Contract Documents, at no increase in cost to the Owner.

B. Coordination: Coordinate the work with all trades that may be affected by the work to avoid conflicts and to allow for an organized and efficient installation of all systems.

C. Examination and Preparation: Examine installation conditions and verify they are proper and ready for the work to proceed. Verify compatibility of materials in contact with other materials, and suitability for conditions they will be exposed to. Do not proceed with the work until unsatisfactory conditions have been corrected. Prepare area to accept the work and prepare products for the installation.

D. Field Conditions: Check field conditions and verify all measurements and relationships indicated on the drawings before proceeding with any work. In verifying existing conditions, the Contractor shall verify by direct physical inspection, complete tracing out of systems, by applying test pressures, by excavation and inspection, use of pipeline cameras, and other suitable absolute certain methods to confirm the actual physical conditions that exist.

E. Openings and Cutting and Patching in Existing Construction:

1. Openings--General: Provide all openings and cutting as needed to accommodate all work. Provide patching to restore all damaged and disturbed areas to pre-construction conditions (or better). The Contractor or subcontractor requiring the opening shall be responsible for making that opening. The opening shall be made by skilled labor experienced in providing openings in the material being penetrated.
2. Areas to Be Cut and Patched: Wherever floors, walls, ceilings, plates, firestops and framing members are cut, these openings shall be substantially reinforced and sealed so as to maintain the strength and sealing ability of the element equal to that as if it had not been cut. All reinforcement/sealing shall satisfy the Architect/Engineer and comply with the governing codes. Such cut areas shall be patched and restored to a finished condition, equal to adjacent final finished areas that have not been cut.
3. Cutting of Structural Features: Make no cuts or alterations to any structural framing members without explicit consent of the Engineer, and then only under his direction. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. All required cutting to install material shall be accomplished with the use of saw cutting equipment.
4. Patching Materials: Patching shall be with materials of like kind and quality of the adjoining surface by skilled labor experienced in that particular trade.

F. Cleaning: Clean all products (whether exposed to view or not) of all construction debris, and other materials; grease and oil spots shall be removed with appropriate cleaning agents and surfaces carefully wiped clean. Where cleaning cannot restore items to new conditions, the item shall be replaced with new.

3.02 INSTALLATION

A. General: Work shall be in accordance with manufacturer's written installation instructions, code, applicable standards, and best construction practices.

B. Space Verification: Prior to ordering materials verify that adequate space exists to accept the products, along the installation path, and to allow for proper maintenance access. Select products that will fit the space available; some optional materials (i.e. valve types, fitting types, substitutes manufacturer’s etc.) may not be suitable. Verification shall be by direct field measurement of the actual space available and use of manufacturer’s final submittal dimensions. Where the project involves new construction and long lead items and a time schedule not allowing for such direct field measurements, confirm in writing with all trades associated with building the space that adequate room is available. Review maintenance and service access space required and confirm requirements will be met. No submittals shall be made until such space verification work has been performed, and confirmed that adequate space is available. By virtue of making a submittal that Contractor affirms he has completed this verification.

C. Installation Locations:

1. General: Unless dimensioned locations for items are shown, select the precise location of the item in accordance with the Contract Documents, coordinated with other trades and item connection locations, and subject to the Architect/Engineer's review. No allowances will be granted for failure to obtain the Architect/Engineer's review, failure to coordinate the work, and failure to comply with Contract Document requirements.

2. Manually Operated Components: Valves, damper operators, on/off switches, keypads, controls, and other devices which are manually adjustable or operated shall be located so as to be easily accessible by a person standing on the floor adjacent to the item. Any such items which are not in the open shall be made accessible through access doors in the building construction. See individual specification sections for additional requirements.
3. Monitoring Components: Gauges, thermometers, instrumentation, and other components which display visual information (i.e. operating conditions, alarms, etc.), shall be located and oriented so as to be easily read by a person standing on the floor. Provide necessary brackets, hangers, remote read devices and accessories as needed. Equipment control panels and graphic displays furnished with equipment (or integral to equipment) shall be located to be easily accessible by a person standing on the floor adjacent to the equipment, and be located between 4-feet and 6-feet above the finished floor.
4. Installation Issues: If circumstances at a particular location make the accessible installation of an item difficult or inconvenient, the situation shall be discussed with the Architect/Engineer before installing the item in a location that will result in poor access.
5. ADA Accessibility: Locate items which are required to be ADA accessible in accordance with code (including but not limited to IBC, ICC A117.1 and local amendments) for accessibility; verify accessibility requirements with the AHJ.

D. Replacement and Maintenance: Install mechanical equipment to permit easy access for normal maintenance, and so that parts requiring periodic replacement or maintenance (e.g. coils, heat exchanger bundles, sheaves, filters, bearings, etc.) can be removed. Relocate items which interfere with access or revise item installation location, orientation, or means of access.

E. Rotating Parts: Belts, pulleys, couplings, projecting setscrews, keys and other rotating parts which may pose a danger to personnel shall be fully enclosed or guarded in accordance with Code, and so as not to present a safety hazard.

F. Dissimilar Metals: Provide separations between all dissimilar metals. Where not specified in another way, use 10 mil plastic tape wrapped at point of contact or plastic centering inserts.

G. Electrical Offsets: Provide offsets around all electrical panels (and similar electrical equipment) to maintain space clear above and below electrical panels to structure, and clearance of 3.5 feet directly in front of panel, except where indicated otherwise or required by code to be more. Such required offsets are typically not shown on the plans but are to be provided per this paragraph. Include in bid offsets for all systems near electrical panels.

H. Pressure Tests: Maintain documentation of all pressure (and leakage) tests performed on systems and submit with project closeout documents. Records shall contain (as a minimum): date of test, system name, description portion of system being tested, method of test, initial and final test pressures (or of measured leakage rates, as applicable), indication of test pass or fail, name and signature of individual performing (or documenting) the test, initials of independent witness of test.

3.03 PAINTING

A. General: Painting shall comply with Division 09 specifications regarding painting. Colors, in all cases, shall be as selected by the Architect/Engineer.

B. The following painting shall be provided under Division 20: The inside of all ductwork (including visible dampers, roof vents, insulation pins, and any visible metal) behind grilles, registers, diffusers, and louvers shall be painted flat black.

3.04 PENETRATION PROTECTION

A. Exterior and Watertight Penetrations: Where any work pierces the building exterior (or construction intended to be watertight) the penetration shall be made watertight and

weatherproof. Provide all necessary products (e.g. caulking, flashing, screens, gaskets, backing materials, siding, roofing, trim, etc.). Where not detailed or indicated how to install submit shop drawings of the proposed methods. Flashing arrangements shall be per SMACNA Architectural Sheet Metal Manual unless noted otherwise. Caulking alone is not an acceptable means of sealing penetrations.

B. Equipment: Equipment or products located outdoors shall be watertight (except for provisions designed to intentionally accept water and having drain provisions) and shall be designed and intended by the manufacturer to be used outdoors at the project location. Where any work pierces the unit casing exposed to the outdoors the penetration shall be made watertight and weatherproof; provide all necessary products (e.g. caulking, flashing, gaskets, backing materials, etc.).

C. Animal Protection: Mechanical system openings, overhangs, shrouds, coverings, gaps below units, and other elements where animals could enter or occupy shall be protected with screens to prevent animal entry or occupation. Screening shall be installed in a neat professional manner, square to the adjacent construction, and be securely attached with removable fasteners.

3.05 START-UP

A. General: Provide inspections, start-up and operational checks of all mechanical systems and equipment. Maintain documentation of all start-up work and submit with project closeout documents. See individual specification Sections for additional requirements.

B. Personnel: Inspection and start-up services shall be done by individuals trained in the operation, and knowledgeable with, the systems being started-up. Equipment start-up shall be by the manufacturer's authorized service representative where indicated (see individual specification Sections).

C. Scheduling and Agenda: Submit a proposed detailed start-up schedule with proposed dates and times at least 30 days prior to the earliest proposed system start-up. Revise dates and times as mutually agreed upon with trades involved, and witnesses, before submitting a final start-up schedule.

D. Witnessing: Start-up may be witnessed by the Engineer and Owner's representative (at their option). Notify the Engineer and Owner 7 days prior to the proposed start-up time.

3.06 OWNER INSTRUCTION

A. General: Provide instruction to the Owner on the operation and maintenance of all installed mechanical systems.

B. Personnel: Instruction on the operation and maintenance of products shall be by individuals trained and experienced in the installation, operation and maintenance of these products. Instruction shall be by the product manufacturer's authorized service representative where indicated (see individual specification Sections).

C. Scheduling and Agenda: Submit a proposed instruction schedule (with proposed dates and times) and an instruction agenda at least 30 days prior to the earliest proposed instruction period. Coordinate Owner and Architect/Engineer review and arrange mutually agreed upon instruction schedule and the instruction agenda, and submit a final instruction schedule and agenda. Organize instruction by sub-systems corresponding to the project specifications (or similar logical grouping).

D. Instruction: Demonstrate and explain normal start-up, normal shut-down, normal operation, normal settings, adjustments, signs of abnormal operation, emergency shut-down, safety concerns, and related information. Demonstrate and explain system maintenance

requirements with references to the O&M Manual. Show how maintenance is performed, including how items are accessed, maintenance procedures, tools and parts required, and related information. Review typical repairs and explain how performed.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Protection of Items from Damage.

B. Maintaining Utilities and Building Services.

C. Cleaning.

D. Temporary Systems.

E. Review of Existing Conditions.

F. Cutting and Patching.

G. Deactivation and Cap-off of Systems.

H. Mechanical Demolition and Disposal.

1.03 DEFINITIONS

A. “Remove”, "demo", and "demolish" mean "Remove and legally dispose of item and item accessories; except where indicated to be reinstalled, salvaged, or some other required work is indicated."

PART 2 PRODUCTS

2.01 GENERAL

A. Materials: All materials used for capping, temporary piping, repairs, reconnecting, reinstalling, and related work shall be same as specified for new systems.

PART 3 EXECUTION

3.01 GENERAL

A. Protection: Existing items not being demolished shall be protected against damage. Where necessary to prevent damage or necessary to accomplish other work, items shall be disconnected and moved to a suitable protective storage location during the project and then reinstalled to their original location.

B. Utilities and Building Systems: Maintain existing utilities and building systems in service (unless indicated otherwise) and protect from damage during project. Where utilities or building systems must be shut-off to accomplish the work, see drawing notes, Section 20 05 00, and Division 01 for downtime limitations and Owner coordination and notification requirements; coordinate interruptions with other trades.

C. Cleaning: All existing items that remain during construction and were affected by the construction shall be cleaned to a like new condition.

D. Equipment and System Contents: Equipment and systems contain fluids that are typical for such items (e.g. HVAC units contain refrigerant, oils; hydronic systems contain ethylene glycol, corrosion control chemicals, etc.) and require special removal methods and disposal.

E. Existing Items:

1. Information and Field Verification: Routing, locations, and identification of existing items on plans are approximate and are limited. The relative location of systems shown on plans has not been verified, and is schematic only. Field verify locations, contents, and flow direction of all piping and ducts prior to performing any work associated with such systems (see also Section 20 05 00). Do not rely on existing labeling of systems; such labeling shall be considered wrong until verified by other physical evidence.
2. Work Around: Existing building cavities (ceiling spaces, walls, etc.) contain a multitude of systems (e.g. conduit, wiring, fire suppression, light fixtures, low voltage system components, piping, ducts, etc.) typical for buildings of the type of this project. Added effort is required to identify and locate these systems, to work around such systems, and to temporarily disconnect and reconnect (and possibly remove and store) various building components to accommodate the work. Existing building elements will also require the work to be installed in smaller sections (i.e. shorter pipe or duct lengths) than normally possible, and to make system connections in awkward or cramped locations.
3. Revisions: Revise existing systems as needed to accommodate project work and new finishes. Work shall include adjusting locations of items to suit new ceiling heights, revisions to building element locations, revisions to finishes, and other changes.
4. Electrical: Verify voltage, phase, horsepower, panel circuits, and other electrical parameters of existing items prior to beginning work and ordering replacement products. Electrical data listed on the drawings for such items has not been field verified.

F. Cutting: Provide all cutting and openings as necessary to accomplish the work indicated. No structural members shall be cut unless Structural Engineer’s approval is obtained first. Assume all building members are “structural” unless clearly evident otherwise. See Section 20 05 00 and Division 01 for additional requirements.

G. Patching: Patch all wall/floor/ceiling/roof openings left by removal of existing items where wall/floor/ceiling/roof is to remain. Patch with materials and workmanship so as to match finish of adjacent undisturbed area, and to provide conditions equivalent to the original new construction.

H. Disposal: Dispose of all demolished items and all waste materials off site in accordance with code and legal requirements.

I. Owner's Salvage: Owner has first right to all items shown to be demolished. All items not wanted by Owner, and not indicated to be salvaged for reuse, shall be removed by the Contractor.

3.02 REVIEW OF EXISTING CONDITIONS

A. General: Provide field investigation of all systems and existing conditions to confirm extent of demolition, routing of existing systems, existing building materials of construction, mechanical system types and materials involved, areas where cutting and patching is required, site access, sizes of existing system components, and all other aspects of existing building and systems and their relationship to the Work.

B. Review Timing: Review existing conditions prior to bidding, again prior to commencing any work or ordering materials, and continually throughout the project.

C. Review for Space and Routing:

1. Review existing conditions (including dimensions) where equipment must be moved through to confirm adequate space and path.

2. Review existing conditions (including dimensions and locations of existing systems) where work will occur to determine impact on the locations and routing of new systems; include time to develop shop drawings and revisions to routing shown on the design drawings to accommodate existing conditions.

D. Existing Record Drawings: Existing record drawings do not exist.

E. Construction Thickness: Where needed to perform the work, and to prevent damage to adjacent construction, verify the thickness of existing concrete floors and other elements by selective drilling or saw cutting.

3.03 DEMOLITION

A. General: Review site conditions and identify all demolition work; include in bid all costs for demolition and disposal. Coordinate all demolition work with other trades. Confirm items to be salvaged or reused, and overall demolition scope.

B. Scope: Not all items to be demolished are necessarily shown on the drawings, but are covered by notes and specifications. In addition to demolishing items indicated, demolish all associated items (unless indicated otherwise); this includes such items as supports, insulation, piping, drains, control wiring/conduit, power wiring/conduit, unions, valves, and similar accessories. Demolish all utilities serving demolished items completely or back to active mains where mains are to remain active; assume such utilities extend at least forty feet from the demolished items (unless indicated otherwise). Demolish all mechanical items located in building elements which are being demolished (i.e. located in walls, chases, roof assemblies, etc.). Demolish items as required to accomplish the work.

C. Prevent Damage: Where existing building systems are to be reused to serve new items, carefully execute the demolition work to prevent damage to items to be reused and to prevent the demolition of items that are intended for reuse.

D. Depth: Abandoned items, anchors, inserts, and other projections embedded in existing construction and not being concealed by new construction shall be removed to 1" below the adjacent finished surface, and the disturbed area patched.

E. Cap-Offs and Terminations:
1. Permanent: Provide cap-off of all existing utilities and systems that are cut or served demolished items. All cap-offs shall occur in concealed locations (unless indicated otherwise). Cap-off's shall be of equivalent material as the item being capped and be insulated where the connected system was insulated or where doing so will reduce energy consumption or prevent condensation.
2. Temporary: Provide temporary cap-off of all existing utilities and systems to allow continued use of all systems until the final system components are installed and connected.
3. Wiring Terminations: Terminate all control wiring and electrical power connections in a manner that complies with code and allows remaining items to function as intended.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Thermometers.

B. Pressure Gauges.

C. Strainers.

D. Unions.

E. Flexible Connectors.

F. Access Doors.

1.03 SUBMITTALS

A. General: Comply with Section 20 05 00.

B. Product Data: Submit product information data for all items to be used.

1.04 REFERENCES

A. ANSI Z21.24: Connectors for Gas Appliances.

B. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings.

C. ASME B16.39: Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300.

D. ASME B40.3 - Bimetallic Activated Thermometers.

E. ASME B40.100 - Pressure Gauges and Gauge Attachments.

F. IFGC: International Fuel Gas Code.

G. IMC: International Mechanical Code.

H. UPC: Uniform Plumbing Code.

1.05 GENERAL REQUIREMENTS

A. Domestic (Potable) Water Systems: All items in contact with potable water shall be lead free in accordance with ANSI/NSF 61. Plastic piping system components shall comply with ANSI/NSF 14.

B. System Requirements: Products shall comply with additional requirements cited for the specific systems the products are being installed in; see specific system specification sections.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Paragraph 2.01, Acceptable Manufacturers.

B. Unions: Anvil, Nibco, Watts, Epco, Victaulic, Ward, Jefferson Union.

C. Dielectric Connecters: Victaulic Precision Plumbing Products, Elster Perfection.

D. Flexible Connectors: Universal, Mason, Dormont, OPW, Unisource, Twin City Hose.

E. Escutcheons: Selected by Contractor.

2.02 UNIONS

A. Dielectric Unions: Shall not be used. Provide “dielectric connector” with standard union where union is required at connection point of dissimilar materials.

B. Unions on Copper Pipe:
   1. General: Pressure and temperature ratings to match (or exceed) piping system being installed in; minimum Class 125.
   2. 2-Inch Pipe and Smaller: Wrought copper solder joint copper to copper union, complying with ASTM B16.18.

C. Unions on Steel Pipe:
   1. General: Pressure and temperature ratings to match (or exceed) piping system being installed in; minimum Class 150.
   2. Threaded: Malleable iron union, threaded connections, with ground joints, complying with ASME B16.39. Provide with brass-to-iron seat (except provide iron-to-iron seat where the conveyed material is detrimental to brass).
   3. Welded and Flanged: Flange unions; see individual system specification sections.

D. Dielectric Connector: Schedule 40 steel pipe nipple, zinc electroplated, with internal thermoplastic lining which is NSF/FDA listed and meeting all code requirements for potable water applications. Suitable for continuous use up to 225 deg F and 300 psi. "Clearflow" dielectric waterway (or approved). For systems operating at temperatures greater than 225 deg F provide flanged connections with insulating gaskets.

2.03 FLEXIBLE CONNECTORS

A. Piping Flexible Connectors: General Use: Corrugated hose type with outer braided wire sheath covering. Corrugations shall be close pitch annular type. Minimum working pressure of 250 psig, minimum length of 12 inches (or 12 times the connector's nominal diameter, whichever is more), and screwed or flanged end connections. Metal for hose shall be bronze or stainless steel; braided sheath shall be stainless steel, any type of ASTM 300 series.

2.04 ESCUTCHEONS

A. Type: Circular metal collar to seal pipe penetrations at building elements (i.e. walls, floors, cabinets, and ceilings); one piece type except that split hinge type may be used for applications on existing piping.

B. Construction: Constructed of chrome plated brass or polished stainless steel, sized to tightly fit pipe exterior surface (or pipe insulation where insulated) and to fully cover the building element penetration.

C. Projection: Shallow face type with maximum projection from wall not to exceed 1.2 times inner diameter of escutcheon.

D. Special Applications: For sprinkler heads and similar special applications see items’ specification Section.

PART 3 EXECUTION

3.01 INSTALLATION

A. Unions: Install unions in pipe connections to control valves, coils, regulators, reducers, all equipment, and where it may be necessary to disconnect the equipment or piping for repairs or maintenance; and as indicated. Where flanged connections occur at equipment additional unions are not required unless indicated otherwise. Dielectric unions shall not be used.

B. Dielectric Connectors: Install connectors between all connections of copper and steel piping (or equipment), and other dissimilar metals. Where flanged connections occur use insulating type flanges. Dielectric unions shall no be used.

C. Escutcheons: Provide at all pipe penetrations through building elements, except where penetration is concealed (unless specifically noted otherwise). Items located in accessible cabinet spaces (e.g. below sinks) are not considered concealed.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Pipe Hangers and Supports.

B. Duct Hangers and Supports.

C. Mechanical Equipment Anchors and Supports.

1.03 QUALITY ASSURANCE

A. Pipe Hanger Standards: Manufacturers Standardization Society (MSS) Standards SP-58, SP-89, SP-69, and SP-90.

B. General: All methods, materials and workmanship shall comply with Code; including IBC, IMC, UPC, NFPA Standards, and ASME standards.

1.04 SUBMITTALS

A. General: Submittals shall comply with Section 20 05 00.

B. Product Data: Submit product data for all hangers, supports, and anchors. Data to include finish, load rating, dimensions, and applicable agency listings. Indicate application for all items by system type, size, and other criteria as appropriate to project.

1.05 GENERAL REQUIREMENTS

A. Seismic: Provide adequate hangers, supports, anchors, and bracing to serve as seismic restraints. Seismic anchoring and bracing methods shall comply with SMACNA SRM, Mason SRG, and code. Seismic restraints system shall be able to withstand seismic forces as required by code but no less than two times the weight of the supported (or anchored) item (including contents) in an upward direction and a force equal to the weight of the item (including contents) in a horizontal direction, without placing excess stress on the item or allowing excess movement of the item (i.e. movement that would cause damage to the item or adjacent items or cause support failure). Forces on equipment shall be applied to the center of gravity of the equipment.

B. Design and Manufacture: All pipe hangers and supports shall be designed and manufactured in accordance with MSS-SP 58.

1.06 REFERENCES

A. ADC: Air Duct Council - Flexible Duct Performance and Installation Standard, 5th Edition.

B. ASHRAE-F: American Society of Heating, Refrigeration, and Air Conditioning Engineers, Handbook of Fundamentals.

C. ASME B31.1: Power Piping.

D. ASME B31.9: Building Services Piping.

E. ASTM A108: Standard Specification for Steel Bar, Carbon and Alloy, Cold - Finished.

F. ASTM A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

G. ASTM A153: Standard specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

H. ASTM A653: Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

I. ASTM A907: Standard Specification for Steel, Wire, Epoxy - Coated.

J. ASTM A924: Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot Dip Process.

K. IBC: International Building Code.

L. IMC: International Mechanical Code.

M. Mason SRG: Mason Industries Seismic Restraint Guidelines for Suspended Piping, Ductwork, Electrical Systems and Floor Mounted Equipment, 6th Edition.

N. MSS SP-58: Pipe and Hangers and Supports - Materials, Design and Manufacture.

O. MSS SP-69: Pipe and Hangers and Supports - Selection and Application.

P. MSS SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices.

Q. MSS SP-90: Guidelines on Terminology for Pipe Hangers and Supports.

R. SMACNA-DCS: HVAC Duct Construction Standards, 3rd Edition.

S. SMACNA SRM: Seismic Restraint Manual Guidelines for Mechanical Systems, 2nd Edition.

T. UPC: Uniform Plumbing Code.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Paragraph 2.01, Acceptable Manufacturers.

B. Hangers and Supports: Grinnell, B-Line Systems, Unistrut, Erico, PHD, Basic-PSA, Pate, Caddy, Unisource, Metraflex, American Insulation Sales, Thermal Pipe Shields.

C. Anchors: Rawplug, Phillips, Hilti, Michigan, Simpson, Fastenal, Grinnell, B-Line Systems, Unistrut, PHD, Basic-PSA, Metraflex.

2.02 GENERAL

A. Finish:
   1. Indoor Applications: Electro-plated zinc in accordance with ASTM B 633, or hot-dip galvanized after fabrication in accordance with ASTM A 123; except that hanger straps may be formed from pre-galvanized steel.
   2. Outdoor Applications: Hot-dip galvanized after fabrication in accordance with ASTM A 123, ASTM A 153, or ASTM A 653 (as applicable to item).

B. Identification: Steel pipe hangers and supports shall be stamped with the manufacturer’s name, part number, and size.

C. Hanger Rods: Threaded hot rolled steel. Hanger rods shall be sized so that the total load imposed (including pipe or duct, insulation, hangers, and fluid) does not exceed the following:

Nominal Rod Diameter	Maximum Load
1/4 Inch	240 Pounds
5/16 Inch	440 Pounds
3/8 Inch	610 Pounds
1/2 Inch	1130 Pounds
5/8 Inch	1810 Pounds
3/4 Inch	2710 Pounds
7/8 Inch	3770 Pounds
1 Inch	4960 Pounds

D. Hanger Straps: Galvanized steel, minimum 1" x 22 gauge (except where required by Code to be heavier or noted otherwise), of lock-forming grade conforming to ASTM A924, G90 (minimum) galvanized coating conforming to ASTM A 653. Minimum yield strength of 30,000 psi. Straps shall be sized so that the total load imposed does not exceed the following:

Strap Size	Maximum Load
1” x 22 Gauge	230 Pounds
1” x 20 Gauge	290 Pounds
1" x 18 Gauge	380 Pounds
1" x 16 Gauge	630 Pounds
1-1/2" x 16 Gauge	990 Pounds

E. Concrete Anchors: Wedge type expansion anchors, with hex nut and washer, and stainless steel split expansion rings. Tested to ASTM E 488 criteria, UL listed, with exposed anchor head stamped with code to identify anchor length.

F. General Anchors (Screws, Nuts, Bolts, Fasteners):

1. General: Constructed of materials suitable for the conditions exposed to and materials being joined, with minimum 50 year service life. Stainless steel construction where exposed to corrosive conditions. Configuration, size and grade to suit application, accommodate expected forces, and provide anchoring to structural element (or allow for proper fastening of items). Minimum safety factor of 2.5 (or as required by code, whichever is greater). Comply with ASTM A307, SAE J429, SAE J78, or ASTM A 563; bolts and nuts shall have unified inch screw threads (course, UNC).
2. Test Reports: Provide independent test report indicating fastener strength (pullout and shear) as installed in the materials and applications of this project (when required by the Engineer or AHJ).
3. Finish: In finished areas, the portion of fastener exposed to view shall match the exposed finish of item being fastened.
4. Vandal Resistant Type: Require unique tool to remove; two-hole spanner type, torx-head type, or equivalent. Coordinate with other trades and use same type through-out project (unless noted otherwise).
5. Security Type: Require specialty tool to remove; as specified in Division 01. Where not specified in Division 01 shall be six star torx-head with raised center pin. Coordinate with other trades and use same type through-out project (unless noted otherwise). Provide three tools for each different size fastener used in the project.

G. Manufactured Strut Systems:

1. Channels: Minimum 12 gauge, 1-5/8 x 1-5/8" (unless noted otherwise), with slots/holes to suit application.
2. Accessories: Channel nuts press formed, machined and hardened with gripping slot, fabricated from steel conforming to ASTM A 108 or ASTM A 36. Fittings fabricated from steel in accordance with ASTM A 907.
3. End Caps: Vinyl cap, capable of withstanding high temperatures without degradation, manufactured specifically for use with manufactured strut. Unistrut Series P2859 or P2860 (or approved).

H. Steel: Structural steel per ASTM A 36.

I. Field Galvanizing Compound: Brush or spray applied galvanizing treatment; consisting of a premixed ready to apply liquid organic zinc compound, with 95% metallic zinc content by weight in dry film. ZRC worldwide “ZRC Cold Galvanizing Compound”.

J. Rooftop Pipe Supports: Designed for rooftop support of piping to distribute load evenly over roof surface; factory fabricated. Shall be constructed of thermoplastic, polycarbonate, or polyethylene material, with attached strut support for anchoring of pipe, pipe attachment hardware, and sized to suit piping used with and so that pressure on roof does not exceed 150 pounds per square foot. Provide style with height to match pie height requirements above the roof. Strut and hardware shall be hot-dipped galvanized or have electro-galvanized finish. Plastic materials shall have UV stabilizers to resist UV deterioration. For piping systems subject expansion and contraction, provide roller type support allowing pipe movement, having a foam bottom to minimize roof abrasion. Caddy “Pyramid ST”, Pyramid 50”, “Pyramid 150”, Pyramid RL”.

K. Rooftop Equipment Sleepers: Factory fabricated sleepers, constructed of minimum 18 gauge galvanized steel, all joints fully welded, with integral base plate pressure treated top wooden nailer, and integral top flashing having side turndown over wood nailer. Size to suit equipment supported, with minimum height above roof as indicated, and configuration to suit roof and roof insulation used with. Pate Co. “es-Equipment Supports”, Thybar “TEMS”, (or approved equal).

2.03 PIPE HANGERS AND SUPPORTS

A. Copper Pipe: All hangers used directly on copper pipe shall be copper plated or have a factory applied 1/16-inch thick (minimum) plastic coating on all contact surfaces.

B. Cushion Clamps: Pipe clamps with a vibration dampening insert between the pipe and clamp, with a nylon inserted lock-nut on clamp. Insert shall be constructed of a thermoplastic elastomer, designed to tightly fit and match pipe size and clamp used with; suitable for system temperatures.

C. Type: Shall be MSS type selected in accordance with MSS-69; except that MSS type 24, 26, and 34 shall not be used.

D. Trapeze Hangers: Shall be constructed of carbon steel angles, manufactured strut channels, or other structural shapes with flat surface (or installed saddle) for pipe support. Provide steel washer where hanger rod nuts bear on trapeze hanger. Pipe anchors shall be two piece clamp type designed for use with trapeze style (i.e. inserted into strut channel opening) or one piece type designed for welded or bolted attachment to trapeze; shaped to match pipe size (or pipe size plus insulation thickness on insulated systems). Pipe guides shall comply with paragraph titled “Alignment Guides”; or be steel angles with vertical leg height equal to pipe diameter (or pipe diameter plus insulation thickness on insulated systems); or be two piece clamp type pipe anchors sized and installed to serve as a guide.

E. Insulated Pipe Supports:
   1. Insulation material at pipe support shall consist of expanded perlite, calcium silicate or high density phenolic. Where located outdoors or used on chilled water piping, insulation material, shall be water resistant. Insert shall have a flame resistant jacket of nylon reinforced kraft paper bonded to aluminum foil cover on insulation, with galvanized steel shield. Insulation material shall have no more than 5% deformation at 100 psi and a thermal conductivity no more than 0.32 Btu/hr-sf-deg F-inch (rated at 75 deg F). Insulation shall be suitable for temperatures and conditions it will be exposed to without degradation over a 30 year life.
   2. All insulation and materials shall have a fire hazard rating not to exceed 25 for flame spread and 50 for smoke development, as tested by ASTM E84.

3. Insert shall be same thickness as adjoining pipe insulation, sized to match pipe diameter used on.
4. Minimum insulation and shield lengths, and minimum shield gauge:

Nominal Pipe Diameter In Inches	Insulation Length In Inches	Shield Length In Inches	Minimum** Shield Gauge
1/2 to 1	*	4	20
1-1/4 to 2	6	4	20
2-1/2 to 6	6	4	18
Larger Sizes	9	6	16

* Insert not required; shield at insulation is acceptable.
** Provide with 360° shield where pipe is clamped (or has a 360° anchor).

2.04 DUCT HANGERS AND SUPPORTS

A. Hangers: As shown in SMACNA-DCS except that wire shall not be used and all materials used shall comply with these specifications.

B. Vertical Duct Supports at Floor: 1-1/2" x 1-1/2" x 1/8" (minimum) galvanized steel angle and to support ducts, maximum 12 foot on center, and as shown in SMACNA-DCS. For ducts over 30 inches wide provide riser reinforcing with hanger rods between the riser support and riser reinforcing.

C. Vertical Duct Supports at Wall: 1-1/2" x 1/8" (minimum) strap or 1-1/2" x 1-1/2" x 1/8" (minimum) angle bracket and as shown in SMACNA-DCS.

D. Hanger Attachments to Structure: As shown in SMACNA-DCS to suit building construction and as allowed on structural drawings. Provide washers at all fasteners through hanger straps (regardless of SMACNA-DCS allowances). Where C-clamps are provided, retainer clips shall be used. Friction beam clamps shall not be used.

E. Hanger Attachments to Ducts: As shown in SMACNA-DCS except that wire shall not be used as any form of support or attachment for ducts.

F. Flexible Duct Strap: Woven polypropylene hanging strap, minimum tensile strength of 400 lbs, minimum 1.75-inches wide, designed and intended for flexible duct support.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. General: Provide all necessary bolts, nuts, washers, fasteners, turnbuckles, hanger rods, rod connectors, stanchions, wall/roof/floor backing and attachments, bridging between structural members, and any other miscellaneous accessories required for the support and anchoring of all pipes, ducts, and mechanical equipment. All supports, whether from floor, walls, or hung from structure, are Contractor's responsibility. Anchors and supports shall be adequate to accommodate forces equipment will be exposed to. Any field cut pieces of galvanized materials shall be hot-dip galvanized after cutting; or be solvent and wire brushed clean and receive field applied galvanizing treatment. This field applied galvanizing (only allowed with prior permission for minor localized cuts) shall use multiple coats to provide as near equal protection as possible to factory (or hot-dip) applied coatings.

B. Backing: Install steel or wood backing in walls (anchored to studs) and in ceiling (anchored to joists or trusses), as required to provide support for items.

C. Installation: Install all inserts, anchors, and supports in accordance with manufacturer's instructions, code requirements, and best professional practices. The most restrictive criteria governs.

D. Welded Assembly Finish: All welded steel support assemblies shall have a power wire brush and primer paint finish where installed indoors and be have factory applied hot-dip galvanized finish where installed outdoors (or subject to moisture); unless another finish is specified.

E. Attachments: Attach to anchoring element (i.e. building structure, concrete pads, etc.) as shown on drawings (reference structural drawings). Where not detailed on the drawings, the Contractor shall design and submit shop drawings of proposed attachment methods to the Engineer for review.

F. Application:
   1. Where not detailed on the drawings (or otherwise indicated), the selection and design of supports is the Contractor's responsibility, in compliance with code and Contract Document requirements; subject to submittal review and acceptance by the Engineer.
   2. Exposed supports in finished areas shall be arranged to minimize their visibility; be free of dents, scratches and labels, and be configured in a manner to match the decorum and finish of the room they are installed in. Exposed supports in finished areas shall be cleaned to allow for field painting (unless a chrome, stainless steel, or similar finish has been indicated).
   3. HVAC Support wire and flexible duct strap shall only be used for support of ceiling air inlets and outlets, or at flexible duct supports.

G. Manufactured Strut ("Unistrut"): Provide end caps on all strut ends at the following locations:
   1. Where exposed to view in finished areas.
   2. Where near maintenance access paths.
   3. Where personnel injury could occur if the ends were not covered.

H. Seismic: Provide hangers, supports, anchors and bracing as required by code and as necessary to accommodate forces in a seismic event. Seismic bracing is not required for piping sized 2-inch and less, or for horizontal piping where the distance from the top of the pipe to the support attachment point to the building structure is less than 12-inches (unless noted otherwise). Seismic bracing is not required for ductwork less than 28-inch in diameter or having across sectional area less than 6 square feet, or for horizontal ductwork where the distance from the top of the duct to the support attachment point to the building structure is less than 12-inches (unless noted otherwise). All equipment shall be seismically anchored.

3.02 INSTALLATION OF PIPE HANGERS AND SUPPORTS

A. General: Aboveground pipe shall be anchored to the structure to prevent sagging, to keep pipe in alignment, and to resist the forces the pipe will be exposed to; piping shall be supported independent of equipment so that no loads bear on the equipment. Underground pipe shall be evenly supported in trenches with proper bedding materials; see Section 20 05 90.

B. Adjustment: All pipe supports shall be provided with a means of adjustment for the aligning and leveling of the pipe after installation.

C. Applications: Selection, sizing, and installation of pipe supports and accessories shall be in accordance with the manufacturers recommendations, standards MSS SP-89 and MSS SP-69, UPC, and IMC. Refrigerant piping and similar piping subject to vibration (i.e. high pressure tubing) shall be installed with cushion clamps.

D. Support Spacing: Provide piping support spacing according to the most restrictive of the following: UPC, IMC, ASME B31.1, B31.9, local codes, manufacturers recommendations or Contract Documents specific requirements. Provide supports at each change in direction of piping and at each side of concentrated loads (such as in-line pumps, valves greater than size 5", and similar items). On hubless cast iron piping provide supports at each branch connection;

and hubless cast iron piping greater than size 2" shall have supports on both side of piping couplings.

E. Trapeze Hangers: Four or more pipes running parallel may be supported on trapeze hangers provided the slopes of such pipes allow use of common trapeze. Suspend trapeze hanger from the building structure using hanger rods; attach to the building structure using concrete inserts, beam clamps, or other approved methods. Where trapeze width exceeds 30 inches, and where building attachment restrictions require more anchor points, provide three (or more) hanger rod supports. Provide pipe anchors to secure piping to trapeze on minimum 20 foot spacing; size and install pipe anchor to allow longitudinal movement of pipe (unless noted otherwise) with minimal vertical and transverse movement; where pipe is subject to expansion/contraction provide anchoring and alignment guides per paragraph titled “Thermal Expansion/Contraction”.

F. Vertical Piping Supports: Support piping at each floor line with pipe clamps and at intermediate points as required so that hanger spacing does not exceed allowable spacing and as required to prevent excessive pipe movement and so as to comply with the maximum spacings cited above. Support all pipe stacks at their bases with a concrete pier or suitable support. For vertical pipe drops which occur away from a wall or similar anchoring surface, provide angled bracing from nearest structure on two sides of drop to provide rigid anchoring of pipe drop. Provide riser clamps and vertical supports on all vertical vent piping where the vertical pipe length exceeds 5'.

G. Pre-Insulated Pipe Supports: Protect all insulated pipe at point of support with pre-insulated pipe supports. Such supports shall be in place at time of installing pipe.

H. Underground Pipe: Shall be evenly supported on approved bedding materials, as appropriate for the type of piping being used. Such bedding and backfilling shall be as specified in Section 20 05 90.

3.03 INSTALLATION OF DUCT HANGERS AND SUPPORTS

A. General: Provide anchors and supports for all ductwork. Supports and hangers shall comply with SMACNA-DCS, except that hanger spacing and hanger maximum loads shall be governed by whichever is more restrictive between these specifications or SMACNA-DCS.

B. Hanger Spacing -- Rectangular Duct:

Duct Area	Maximum Spacing
Up to 4 Square Feet	8 Feet
4.1 to 10 Square Feet	6 Feet
10 Square Feet and Up	4 Feet

C. Hanger Spacing -- Round Duct:

Duct Area	Maximum Spacing
Up to 24 Inch Diameter	8 Feet
25 Inch to 48 Inch Diameter	6 Feet
49 Inch Diameter and Up	4 Feet

D. Hanger Spacing - Flexible Duct: 4 feet, and at changes of direction as needed to maintain duct elevation and smooth airflow.

E. Vertical Ducts: Support at each floor level, but in no case less than on 12 foot intervals.

F. Flexible Duct: Support with methods shown in ADC. Metal strap in contact with the flexible duct shall have minimum 1.5-inch width.

G. Fittings: Provide supports at each change in direction of duct for ducts with 4 square foot area or more, or for ducts larger than 24 inch diameter. Locate hangers at inside and outside corners of elbows--or at each end of fitting on each side.

H. Concentrated Loads: Provide additional supports at each side concentrated loads such as modulating dampers (24" x 24" and larger), duct heaters (18" x 18" and larger), sound attenuators (all sizes), and similar items.

I. End of Duct: At end of duct run, hangar shall be located no more than 1/2 the allowed hangar spacing from the end of the run.

3.04 CEILING SERVICES

A. Less than 20 Pounds: Ceiling mounted services, air inlets/outlets, and accessories weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners (or ceiling support members) or to cross runners with the same carrying capacity as the main runners (or support members).

B. 20 to 56 Pounds: Ceiling mounted services, air inlets/outlets, and accessories weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge wire hangers (or minimum 1” x 22 gauge hangar straps) connected from the terminal or service to the ceiling system hangers or to the structure above. These added hangers may be slack.

C. Greater Than 56 Pounds: Ceiling mounted services, air inlets/outlets, and accessories weighing more than 56 pounds shall be supported directly from the building structure by approved hangers.

3.05 MECHANICAL EQUIPMENT ANCHORS AND SUPPORTS

A. General: Provide anchoring and supports for all mechanical equipment. All equipment shall be anchored to (or supported from) the building structure. In lieu of anchoring to the building, anchor outdoor equipment to the concrete pad serving the equipment.

B. Suspended Equipment: Support as indicated on the plans. Where not indicated use the methods shown (or consistent with) Mason SRG and SMACNA-DCS; submit shop drawings of the proposed methods to the Engineer for review.

C. Roof Mounted Equipment: Install on roof curbs or roof sleepers as indicated. Anchor equipment to the curb (or sleeper), with the curb (or sleeper) in turn anchored to the building structure.

D. Vibration Isolation: Equipment shall be supported and anchored in such a way so that no equipment vibration is transmitted to the building structure.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Pipe Sleeves.

B. Duct Sleeves.

C. Duct Closure Collars.

D. Firestop Seals.

E. Non-Firestop Seals.

1.03 DEFINITIONS

A. Firestop System: Specific firestop materials or combination of materials installed in a specific way in openings in a specific rated assembly to restore (or maintain) the fire rating and smoke passage resistance properties of the assembly.

B. Firestop Seal: Same as “Firestop System”.

C. Rated Assembly: Wall, floor, roof, ceiling, roof/ceiling or other construction which is required (by code or the Contract Documents) to have a fire-resistance rating, be a smoke barrier, or to limit the passage of smoke.

1.04 SUBMITTALS

A. General: Shall comply with Section 20 05 00.

B. Product Data: Provide product data on all material to be use. Provide MSDS for all sealants, caulks and similar materials.

C. Shop Drawings – General: Shop drawings of proposed sealing/flashing assembly for roof and exterior wall penetrations.

D. Shop Drawings – Firestop: Provide firestop system shop drawings showing:

1. Listing agency’s detailed drawing showing opening, penetrating items, and firestop materials. Drawing shall be identified with listing agency’s name and number or designation, fire rating achieved, and date of listing for each firestop system.
2. Identify where each firestop system is to be used on the project.
3. Manufacturer’s installation instructions.
4. For proposed systems that do not conform strictly to the listing, submit listing agency’s drawing marked to show modifications and stamped approval by the firestop system manufacturer’s fire protection engineer.
5. Other data as required by the AHJ.

1.05 REFERENCES

A. ASTM A 36: Standard Specification for Carbon Structural Steel.

B. ASTM C534: Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

C. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.

D. ASTM E 814: Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

E. UL 1479: Standard for Fire Tests of Through-Penetration Firestops.

F. UL 723: Surface Burning Characteristics of Building Materials.

G. SMACNA-DCS: SMACNA HVAC Duct Construction Standards, 3rd Edition.

H. SMACNA-ARCH: SMACNA Architectural Sheet Metal Manual, 7th Edition.

I. USGBC LEED: US Green Building Council LEED Reference Guide for Green Building Construction.

1.06 GENERAL REQUIREMENTS

A. Corrosion Protection: All sleeves exposed to water, moisture, chemicals, or subject to corrosion shall be constructed of corrosion resistant materials suitable for the exposure. Steel sleeves shall be hot dip galvanized after assembly. Provide additional coatings as noted or as required to resist corrosion.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Paragraph 2.01, Acceptable Manufacturers.

B. Firestop Seal Materials: 3M, Dow Corning.

C. Non-Firestop Seal Materials: 3M, GE, Dow Corning, Tremco, Pecora, Sonneborn, Pipeline Seal & Insulator.

2.02 PIPE SLEEVES

A. Diameter:
   1. Belowground: Inside diameter of belowground pipe sleeves shall be at least 2 inch larger than the outside diameter of the pipe or pipe covering (for covered piping systems), so as to allow free movement of piping.
   2. Aboveground: Inside diameter of aboveground pipe sleeves shall be at least 1-inch larger than the outside diameter of the pipe or pipe covering (for covered piping systems), so as to allow free movement of piping.

B. Length: Horizontal sleeves through finished areas (where sleeve is exposed to view) shall be sized to be flush with finished surfaces; other horizontal sleeves may terminate flush to 2-inches past the element being penetrated. Vertical sleeves shall be sized to extend one inch above the final floor elevation.

C. Structural Type: Fabricated from schedule 40 steel pipe. Waterstop shall consist of fully welded 2-inch larger diameter collar, minimum 1/4 inch thick steel, located on sleeve so as to be centered within the element being penetrated. Provide waterstop on sleeves where sleeves are installed in the following locations: in cast-in-place concrete, where any part of the sleeve ends are exposed to water, where installed in floors with water-proofing or water stopping membranes, in rooms with floor drains, and where needed for anchoring/support purposes. Prime paint all surfaces with rust-inhibiting paint.

D. Flexible Type: Flexible cellular elastomeric insulation, complying with ASTM C 534, Type 1, minimum 1/2-inch thick. Water vapor permeance shall not exceed 0.08 perms. Operating Temperature Limits -20 degrees F to 180 degrees F. Provide in sheet or pre-fabricated pipe size; provide multiple wraps as required.

2.03 DUCT SLEEVES

A. Size: Inside dimension of duct sleeves shall be at least 1-inch larger than the outside dimension of the duct or duct covering (for covered duct systems). For duct system conveying air or gases operating above 200 deg F provide sleeve dimension minimum 2-inch larger than duct or duct covering (for covered duct systems). Provide larger sleeves where a larger space around duct exterior is required by code, by duct or flue system manufacturer, to provide required thermal clearances, where specifically noted, where unusual conditions are present and where required to accommodate large movement.

B. Length: Horizontal sleeves through finished areas (where sleeve is exposed to view) shall be sized to be flush with finished surfaces; other horizontal sleeves may terminate flush to 2-inches past the element being penetrated. Vertical sleeves shall be sized to extend one inch above the finished floor.

C. Structural Type: Fabricated from schedule 40 steel pipe for round openings and 3” x 3” x 3/8” welded steel angles for other openings (unless noted otherwise). Prime paint all surfaces with rust-inhibiting paint.

D. Flexible Type: Flexible cellular elastomeric insulation, complying with ASTM C 534, Type 1. Water vapor permeance shall not exceed 0.08 perms. Operating Temperature Limits -20 degrees F to 180 degrees F. provide in sheet or pre-fabricated pipe size.

2.04 DUCT CLOSURE COLLARS

A. General: Closure collars shall provide closure of opening between duct and opening in element penetrated and shall abut tight up to and overlap duct and shall consist of rolled angle material (for round ducts) and welded framed angles (for rectangular and round ducts).

B. Size: Closure collars shall be sized to match duct and opening applied to and shall have minimum 2-inch overlap on duct side and 2-inch overlap at opening/penetrated element side but shall completely cover opening in element penetrated with minimum 1-inch overlap to undisturbed element (i.e. wall, floor, etc.).

C. Material: Closure collars shall be fabricated of 20 gauge galvanized steel for ducts 15 inches diameter and less and shall be fabricated of 18 gauge galvanized steel duct for all larger ducts and all square and rectangular ducts.

2.05 FIRESTOP SEALS

A. General: Commercially manufactured through-penetration and membrane-penetration firestop systems to prevent the passage of fire, smoke and gases, and to restore the original fire-resistance rating of the barrier penetrated.

B. Listing: Firestopping shall be listed by UL in “Fire Resistance Directory” (category to match the application), or be qualified by another independent agency acceptable to the AHJ.

C. Rating: Firestop system and devices shall be tested in accordance with ASTM E 814 or UL 1479, with “F” and “T" ratings as required to maintain the fire-resistance rating of the barrier penetrated, and as required by code.

D. Fire Hazard: Materials shall have a flame spread of 25 or less, and a smoke development rating of 50 or less; when tested in accordance with ASTM E 84 or UL 723.

E. Cabling Applications: Firestop systems used with loose electrical cabling shall be the type that allows for removal of the cable or installation of new cables without damage to the firestop system, or the need to replace or repair firestop materials.

F. Insulation: Firestop system shall be applicable to insulated systems to allow the insulation to run continuous through the firestop system (unless noted otherwise).

2.06 NON-FIRESTOP SEALS

A. Indoor Sealants:
   1. Smoke or Sound Sealant Applications: For use where a firestop seal is not required, but smoke or sound seal is required. Single component, elastomeric or acrylic latex type sealant with STC ratings per ASTM E90. Sealants shall be of the following types, or approved equal:
      a. 3M “Smoke and Sound Sealant SS100”.
      b. Tremco “Tremstop”.
   2. Other Areas - Dry (Not Normally Exposed to Water/Moisture): Single component, latex sealant complying with requirements of ASTM C834. Sealants shall be of the following types, or approved equal:
      a. Tremco Corporation “Tremflex 834”.
      b. Pecora Corporation “AC-20 Arylic Latex”.
      c. Sonneborn Building Products “Sonolac”.
   3. Other Areas - Wet (Exposed to Water/Moisture): Single component, mildew resistant silicone sealant complying with requirements of ASTM C920, Type S, Grade NS, Class 25. Color white. Sealants shall be of the following types, or approved equal:
      a. Dow Corning “786 Mildew Resistant Silicone”.
      b. Pecora Corporation “898 Silicone Sanitary Sealant”.
      c. Tremco “Tremsil 200”.

B. Outdoor Sealants:
   1. General: Single component, non-sag, low modulus, silicone elastomeric sealant conforming to requirements of ASTM C920, Type S, Grade NS, Class 100/50. Sealant shall be of the following types, or approved equal.
      a. Dow Corning “790 Silicone Building Sealant”.
      b. Pecora Corporation “890 Silicone”.
      c. Tremco “Spectrem 1”.
   2. Adjacent to Aluminum: Single component, non-sag, medium modulus, silicone elastomeric sealant conforming to requirements of ASTM C920, Type S, Grade NS, Class 50. Sealant shall be primer-less type for use in joints adjacent to fluoropolymer coatings. Sealants shall be of the following types, or approved equal:
      a. Dow Corning “795 Silicone Building Sealant”.
      b. GE Silicones, Momentive, SCS2000 and SCS7000.
      c. Pecora “895 Silicone”.
      d. Tremco “Spectrem 2”.

C. Expanding Foam Sealant:
   1. General: Single component, polyurethane insulating sealant with flame spread index of 25 or less and smoke development rating of 50 or less. Shall expand and fully cure within 24 hours to a semi-rigid, closed cell, water and air resistant foam. Sealant shall be of the following types, or approved equal.
      a. DAP “Kwik Foam”.

b. Fomo Products “Handi-Foam”.
c. Todol Products “EZ Flo Gun Foam”.

D. Link Seal: Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. The seal assembly shall expand when mechanically tightened to provide an absolute water-tight seal between the pipe and wall opening. Sizing shall be per manufacturer's recommendations. Seal shall be Pipeline Seal and Insulator, "Link-Seal" (or approved).

E. Specialty: Packed fiberglass or wool insulation; with silicone sealant rated for use with temperatures and other conditions encountered.

F. Grout: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout. Nonshrink; recommended for interior and exterior applications. Design mix shall provide 5000-psi, 28-day compressive strength. Premixed and factory packaged.

PART 3 EXECUTION

3.01 PIPE SLEEVES

A. General: Provide sleeves for all piping passing through walls, floors, partitions, roofs, foundations, footings, grade beams, and similar elements. Except that sleeves are not required at core drilled penetrations through solid concrete or where formed openings equivalent to a core drilled opening are provided. Sleeves shall be the following type (horizontal/vertical refer to position of sleeve):
   1. Horizontal, Belowground: Belowground on Both Sides of Element Penetrated: Non-structural, belowground, non-waterstop type; except that penetrations of footings shall be structural type.
   2. Horizontal, Aboveground:
      a. Concrete and Masonry Walls: Structural type.
   3. Vertical, Slab on Grade: Structural type; except at piping serving individual fixtures or individual heating units in finished areas, the flexible type may be used. Where not installed to be concealed (as in a plumbing chase) install height of flexible type so it is concealed by the floor finish, cabinet base, or an escutcheon.
   4. Vertical, Not Slab on Grade:
      a. Concrete Floors/Roofs: Structural type.

B. Installation: Set sleeves plumb or level (or sloped as required for sloped pipes) in proper position, tightly fitted into the work. Set sleeves properly in element for specified projection past adjacent surfaces (see sleeve product specification); cut ends of sleeve as necessary.

C. Insulation: Insulation shall run continuous through sleeves (unless noted otherwise).

3.02 DUCT SLEEVES

A. General: Provide sleeves for all ducts passing through walls, floors, partitions, roofs, foundations, footings, grade beams, and similar elements, except that sleeves are not required at core drilled penetrations through solid concrete or where formed openings equivalent to a core drill and provided and where no floor drain serves the room where the penetration occurs. Sleeves shall be the following type aboveground:
   1. Horizontal, Aboveground:
      a. Concrete and Masonry Walls: Structural type.
   2. Vertical, Other than Slab on Grade:
      a. Concrete Floors/Roofs: Structural type.

B. Installation: Set sleeves plumb or level (or sloped as required for sloped duct) in proper position, tightly fitted into the work. Set sleeves properly in element for specified projection past adjacent surface (see sleeve product specification); cut ends of sleeve as necessary.

C. Insulation: Insulation shall run continuous through sleeves (unless noted otherwise).

3.03 DUCT CLOSURE COLLARS

A. General: Closure collars shall be provided for all exposed ducts on each exposed penetration where the duct passes through any floors, walls, ceilings, roofs, partitions, and similar elements. Closure collars shall additionally be provided where so noted on the drawings and at all duct penetrations into mechanical rooms, boiler rooms, and rooms housing mechanical equipment (on both sides of the penetration).

B. Installation: Collar shall be installed tight against surfaces and shall fit snugly around the duct or duct covering. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier of insulated ducts. Collars shall be anchored to element penetrated, with fasteners appropriate to material fastening to, on maximum 6 inch centers.

3.04 FIRESTOP SEALS

A. General: At each through-penetration and membrane-penetration in rated assemblies, where required to limit the passage of smoke, and as required by code or in the Contract Documents, provide a firestop system. Firestop system shall be installed in accordance with the manufacturer's instructions and listing.

B System Selection: Contractor is responsible to select the firestop systems to be utilized, corresponding to the construction of the assembly penetrated, and types of penetrations. Contractor shall submit proposed firestop systems to be utilized, shall also review such systems with the AHJ and obtain AHJ approval.

C. Preparation: Prepare surfaces as recommended by firestop material manufacturer. Examine and confirm that conditions are acceptable to proceed with the installation. Provide maskings and temporary coverings to prevent contamination or defacement of adjacent surfaces.

D. Installation Review:

1. Notify Architect/Engineer when firestopping work is complete and ready for review. Provide minimum 7 days notice to allow scheduling of review. An independent testing agency may be utilized to perform an inspection.
2. Notify AHJ when firestopping work is complete and ready for inspection. Provide sufficient advance notice to allow scheduling of the inspection without adversely impacting project schedule.
3. Do not cover or conceal firestopping until all inspections have been satisfactorily completed.

3.05 NON-FIRESTOP SEALS

A. General: Provide seals around all ducts, conduit, and piping passing through sleeves, walls, floors, roofs, foundations, footings, partitions, and similar elements. Seals shall be watertight where the penetration may be exposed to water or moisture. Provide type of sealant to suit the application. Provide smoke and sound type at all penetrations of rooms which contain mechanical equipment on both side of element penetrated to a depth of 5/8-inch (unless noted otherwise).

B. At Sleeves:

1. Between Sleeve and Penetrated Element: Fill openings around outside of pipe sleeve with same material as surrounding construction, or with material of equivalent fire and smoke rating and properties that allow a tight seal between the sleeve and the surrounding construction. Seal full depth of sleeve for vertical penetrations.
2. Between Pipe and Inside of Sleeve: Provide sealant between outside of pipe or pipe covering (for covered piping systems) and inside of sleeve. Seal depth shall be minimum 1-inch each side. Provide Link Seal type for belowground penetrations, vault wall penetrations, and slab-on-grade penetrations (not required where flexible type sleeves are used).

C. No Sleeves: Provide “Link-Seal” type for belowground penetrations, vault wall penetrations, and slab-on-grade penetrations. Provide sealant at other areas, type to suit the application. Fully seal between outside of pipe or pipe covering (for covered piping systems) and surrounding construction. Seal depth shall be minimum 1-inch each side.

D. Plumbing Fixtures: Provide sealant between fixture and abutting building surfaces. Seal so no water or overspray from fixture can enter building construction. See Section 22 40 00.

E. Preparation: Remove loose materials and foreign matter impairing adhesion of seal. Perform preparation in accordance with recognized standards and sealant manufacturers recommendations. Protect elements surrounding area of work from damage or disfiguration due.

F. Installation: Install sealants immediately after joint preparation. Install sealants free of air pockets, foreign embedded matter, ridges, and sags. Tool exposed joint surface concave and with a neat finished appearance.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Vibration Isolation.

1.03 DEFINITIONS

A. "Equipment" is defined to mean any item with power connections (fans, HV units, AHU units, etc.), and also to include all hoods; but does not include pumps less than 3 hp.

B. "Equipment Requiring Vibration Isolation" is defined to be any equipment (as defined above) with rotating components (e.g. pumps, fans, etc.).

1.04 SUBMITTALS

A. General: Submittals shall comply with Section 20 05 00.

B. Product Data:
   1. Submit product data on all items to be used.
   2. Submit calculations showing vibration isolation selection for all isolation devices provided under this specification section (i.e. where isolation is not furnished integral with the equipment or by the manufacturer of the equipment).

C. Shop Drawings: Submit shop drawings for all fabricated support assemblies.

D. Submit calculations showing seismic restraint calculations, restraint selection, proposed locations of all seismic control bracing, and details of bracing construction.

1.05 GENERAL REQUIREMENTS - VIBRATION ISOLATION

A. General:
   1. Select and provide all vibration isolation devices for all equipment requiring vibration isolation so as to provide complete installed mechanical systems free of the transmission of vibration and vibration generated noise to the structure.
   2. Vibration isolation is shown on the drawings for various items but is not shown for all items requiring isolation. Provide all isolation as indicated and specified herein.

B. Supplier: Where not provided by the equipment manufacturer, all vibration isolation devices and support assemblies shall be supplied as a coordinated package by a single vibration isolation manufacturer, under this specification section.

C. Equipment Manufacturer Items: Isolation devices furnished by equipment manufacturer shall comply with this specification section and be selected by the manufacturer to suit, and provide satisfactory performance, for the applications of this project.

1.06 REFERENCES

A. IBC: International Building Code.

B. IMC: International Mechanical Code.

C. MASON: Mason Industries Seismic Restraint Guidelines for suspended piping, Ductwork, Electrical Systems and Floor Mounted Equipment, 2005 6th Edition.

D. OSHPD: Office of Statewide Health Planning and Development, State of California, Fixed Anchorage.

E. UPC: Uniform Plumbing Code.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Paragraph 2.01, Acceptable Manufacturers.

B. Products: Mason, Peabody, Kinetics Noise Control, Vibration Eliminators, VMC Group.

C. Expansion Devices/Flexible Connectors: Unisource Manufacturing, Twin City Hose, and as specified in Section 20 05 19, 23 21 13, and 23 33 00.

2.02 NEOPRENE ISOLATORS

A. Floor Mounted Isolators: Double deflection neoprene mounts, sized for minimum deflection of 0.30-inch. All metal surfaces shall be neoprene covered, base plate shall have mounting holes, and top shall have threaded steel plate or threaded steel insert. Element shall be color coded or labeled with molded symbols to identify capacity. Neoprene shall be bridge bearing type. Mason Series ND (or approved).

B. Washer Bushings: Bridge bearing neoprene washer insert to provide isolation between anchor bolt and washer from support member/equipment. Mason Series HG (or approved).

PART 3 EXECUTION

3.01 VIBRATION ISOLATION

A. General: Provide vibration isolators for all rotating equipment so that no vibration is transmitted to the structure. Isolators shall be the type indicated; except where not shown, type shall be as selected by vibration isolation manufacturer (or equipment manufacturer) to provide adequate isolation.

B. Installation: Install all vibration isolators in accordance with isolator manufacturer's instructions and isolated equipment manufacturer's recommendations.

C. Inadequate Isolation: Should vibration isolators prove inadequate to prevent transmission of vibrations to the building structure or limit equipment vibration generated noise, such isolators shall be replaced with isolators having the largest deflection that can be practically installed or otherwise modified/replaced to produce satisfactory isolation. Such replacement shall be at no additional cost to the Owner.

3.02 TEST AND INSPECTION

A. Field Inspections: Prior to initial operation, the vibration isolators and seismic devices shall be inspected for conformance to drawings, specifications, and manufacturer's data and instructions. Check all flexible connectors/expansion devices for proper location, guiding, and end anchoring.

B. Vibration Isolator Inspection: After installation of isolators and seismic restraint devices, remove all shipping blocks and other items that may prevent proper isolator operation. Inspect isolators to verify that the machinery moves freely on its spring isolators within limits of stops or seismic restraint devices. Eliminate or correct interferences.

C. Tests: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels. Re-balance, adjust, or replace machinery with noise or vibration levels in excess of those given in the machinery specifications or machinery manufacturer's data. Check for proper operation of expansion devices and associated items during system warm-up.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Excavation.

B. Trenching.

C. Shoring and Trench Protection.

D. Bedding.

E. Backfilling.

F. Compaction.

G. Verification of Existing Utilities.

H. Protection of Utilities.

1.03 DEFINITIONS

A. “Utility Bedding” is defined to mean “material placed beneath the utility for utility support, and material placed adjacent to the utility to the centerline of the utility.”

B. “Utility Zone Backfill” is defined to mean “backfill material that is placed in the area from the centerline of the utility up to the specified height above the top of the utility, and is located above the utility bedding and below the final backfill material.”

C. “Trench Backfill” is defined to mean “backfill material that is placed above the utility zone backfill, and up to rough or finished grade.”

D. “Underground Mechanical Structures” are defined to mean “vaults, tanks, interceptors, separators, manholes, and similar structures buried partially or completely underground.”

E. “Unstable Material” is defined to mean “material that depresses more than 1/4-inch under a load of 2000 pound/square foot, is not firm and stable, or in any way appears incapable of supporting the loads to be imposed.”

1.04 QUALITY ASSURANCE

A. Inspection of Job Conditions: Prior to starting work and during work, the installer shall examine the work by others, site and job conditions under which excavation, trenching, and backfilling for underground mechanical utilities work will be performed, and not proceed with work until unsatisfactory conditions have been corrected.

B. Codes and Standards: Comply with all applicable codes and standards.

C. Experience: Only contractors fully experienced and entirely knowledgeable in the type of work required shall work on this project. By providing bids for this project the Contractor is acknowledging that he has such expertise, and will staff the project with personnel experienced and knowledgeable in the work to be performed.

D. Compaction Testing: Contractor shall provide testing to confirm that the specified compaction levels are being met. Contractor shall keep a record of the location and results of such tests, name of individual performing, and how performed, and have the records on site for Engineer and Owner review. The Owner will retain their own Special Inspector to perform tests (at their discretion) to confirm contract compliance. Notify the Owner of work schedule and coordinate with the Special Inspector to accommodate inspections and tests.

1.05 GENERAL REQUIREMENTS

A. Safety: Contractor is solely responsible for worker safety and for selecting and designing all trench shoring methods, trench protection methods, site utility protection means and other aspects of the work. All such means, methods, and safety measures shall comply with applicable codes and standards, and the requirements of the Contract Documents.

B. Coordination: Coordinate all work with other trades. Coordinate with other Divisions the location and termination of all work of other trades and interconnections with Division 20 work.

C. Scheduling: Schedule work to avoid impacts to other trades due to open trenches, dewatering, and other activities.

D. Existing Utilities: Verify location of all existing utilities that lay in the route of intended work. Verify the location of all existing utilities that will be connected to prior to beginning work for any new utilities.

E. Discrepancies: Notify the Architect/Engineer of any discrepancies or conflicts within the Contract Documents or between the Contract Documents and field conditions. Do not proceed with any work or purchasing of any materials for the area(s) of conflict until obtaining written instruction from the Architect/Engineer on how to proceed. Any work done after discovery of such discrepancies or conflicts and prior to obtaining the Architect/Engineer's instructions on how to proceed, shall be done at the Contractor's expense. In case of a conflict between Division 20 requirements and other project requirements, the most stringent and expensive (as judged by the Architect/Engineer) shall prevail.

1.06 REFERENCES

A. ASTM D 1557, Laboratory Compaction Characteristics of Soil Using Modified Effort.

B. ASTM D 2487, Soils for Engineering Purposes (Unified Soil Classification System).

C. WSDOT Standard Specifications: Washington State Department of Transportation, Specifications for Road, Bridge, and Municipal Construction.

PART 2 MATERIALS

2.01 GENERAL MATERIALS

A. General: All materials used for bedding, backfill, and drainage purposes shall be free of debris, roots, wood, vegetation, refuse, soft unsound material, frozen material, deleterious or other objectionable material.

B. Sand: Clean, free flowing, coarse grade sand, as defined by ASTM D 2487.

C. Pea Gravel: 3/8-inch washed pea gravel; durable particles composed of small, smooth, rounded stones or pebbles meeting the following for grading and quality:

Sieve Size	Percent Passing (By Weight)
1/2" square	100
3/8" Square	85-100

5/8" Square	50-100
U.S. No. 4	10-30
U.S. No. 8	0-10
U.S. No. 16	0-5

2.02 BEDDING MATERIALS

A. Standard: Gravel backfill material, with characteristics of size and shape to allow for compaction, no dimension exceeding 1-1/2 inches, and meeting the following for grading and quality:

Sieve Size	Percent Passing (By Weight)
1-1/2" Square	100
1" Square	75-100
5/8" Square	50-100
U.S. No. 4	20-80
U.S. No. 40	3-24
U.S. No. 200	10.0 max.
Sand Equivalent	35 min.

B. Special: Pea gravel or sand (per paragraph titled “General Materials”).

C. Bedding Material Application:

Utility	Bedding Material	Minimum Thickness*
Cast Iron Piping	Standard (or Special)	4"
Steel Piping/Conduit	Standard (or Special)	4"
Ductile Iron Piping	Standard (or Special)	4"
Plastic Piping/Conduit	Special	4"
Copper Piping	Special	4"
Cable	Special	4"

* Below bottom of utility (unless noted otherwise).

2.03 UTILITY ZONE BACKFILL MATERIALS

A. Standard: Same as specified for standard bedding materials.

B. Special: Minus 3/8-inch washed gravel, or sand.

C. Utility Zone Backfill Material Application:

Utility	Backfill Material	Minimum Thickness***
Cast Iron Piping	Standard (or Special)	4"
Plastic Piping/Conduit	Special	4"

*** Above top of utility (unless noted otherwise).

2.04 PIPE TRENCH BACKFILL

A. Standard: Gravel backfill material, with size and shape to allow for compaction, no dimension exceeding 3 inches, and meeting the following:

Sieve Size	Percent Passing (By Weight)
2-1/2" Square	75-100
U.S. No. 4	22-100
U.S. No. 200	0-10
Dust Ratio	2/3 max.

Sand Equivalent 30 min.

B. Satisfactory Native Material: Excavated material from trenching (or other excavation on site), complying with 2.01 A., having no clods or rocks greater than 3 inches in any dimension.

C. Material Application: Either standard or satisfactory native materials may be used (unless noted otherwise).

2.05 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

A. General: Polyethylene plastic tape manufactured specifically for warning and identification of buried utility lines. Tape shall be minimum 6" wide, acid and alkali resistant.

B. Detectable Type: Minimum 0.004 inch thick, with integral wire, foil backing, or other means to allow detection of tape location. Encase metallic element in protection jacket or other means to provide corrosion protection.

C. Non-Detectable Type: Minimum 0.003 inch thick.

D. Labeling: Tape shall be imprinted with bold black capital letters continuously and repeatedly over the entire tape length. Warning shall read “CAUTION BURIED (utility type) BELOW” or similar wording. Lettering identifying the utility type shall match as closely as possible the designation noted on the plans. Tape lettering shall be permanent and be unaffected by moisture or other materials contained in trench backfill.

PART 3 EXECUTION

3.01 GENERAL

A. Shoring and Trench Protection: Contractor is responsible to design and provide all necessary trench shoring and trench protection to:
   1. Provide safe conditions.
   2. Provide conditions that comply with applicable codes and AHJ requirements.
   3. Prevent undermining of pavement, foundation, slabs, utilities, and other structures.
   4. Prevent movements in adjacent slopes or banks.

B. Workmanship: Work shall abide by best professional practices as described in referenced standards, and as recognized by accredited professionals.

C. Compaction: Provide compaction to percent indicated per ASTM D 1557, of laboratory maximum density. Compact to 95 percent (unless noted otherwise). Compaction shall be accomplished by approved tamping rollers, pneumatic-tired rollers, three-wheel power rollers, or other approved compaction equipment.

D. Grading: Provide grading to prevent surface water from flowing into areas of work to maintain the stability of the work area, and suitable working conditions.

E. Underground Utilities: Location of utilities indicated is approximate. Verify the location of all existing utilities prior to beginning work; utilize field electronic detection equipment, pipe cameras, visual site surveys, and careful exploratory digging at key locations. Coordinate with other trades routing and locations of all new utilities to avoid conflicts and ensure proper connections.

F. Machinery and Equipment: Movement of construction machinery and equipment over buried and backfilled pipes during construction shall be at the Contractor’s risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged. Pressure testing of piping before final Owner acceptance is required to verify no damage has occurred.

G. Protection: Protect all areas of work from traffic, erosion, weather, settlement or other damaging effects. Protect all existing utilities from damage.

H. Jacking, Boring and Tunneling: Unless otherwise indicated, excavation shall be by open cut, except that sections of a trench may be jacked, bored or tunneled if the utility can be safely and properly installed and backfill can be properly tamped in such sections.

I. Buried Warning and Identification Tape: Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade. Provide detectable type over non-metallic piping systems. Piping systems installed within the building footprint does not require identification tape.

3.02 EXCAVATION - GENERAL

A. General: Provide all excavation as necessary to allow for the work indicated. Excavations for underground mechanical structures shall be sufficient to provide a minimum of 12 inches clearance between their surfaces and the sides of the excavation.

B. Excavated Material:
   1. Stockpiles: Stockpile materials satisfactory for backfilling in an orderly manner at a safe distance from the excavation to avoid overloading the sides of the excavated area and to prevent slides or cave-ins.
   2. Protection: Protect stockpiles from contamination with unsuitable backfill materials. Provide adequate drainage at stockpiled areas to prevent water retention in material. If the Contractor fails to protect the stockpiles and any material becomes unsatisfactory as a result, such material shall be removed and replaced with satisfactory on-site or imported material from approved sources at no additional cost to the Owner.
   3. Disposal: Excavated material not required or not satisfactory for backfill or other uses on site shall be removed and disposed off site.

3.03 TRENCH EXCAVATION

A. General: Excavate trenches to accommodate utility, required utility slopes, depths of connecting utility, existing and new utilities, required cover depth, and site conditions.

B. Removal of Unsuitable Material:
   1. Unstable Material: Where unstable material is encountered in the bottom of the trench, such material shall be removed by over excavation of the trench bottom 4 inches below the depth otherwise required. Contractor is responsible for all costs associated with removal and replacement of unstable materials. For bidding purposes, assume that a minimum of 10% of all excavated bottom utility bearing areas will have unstable material.
   2. Rocks and Stones: Stones of 6 inches or greater in any dimension, and any rock or stone of any size/orientation that may disrupt the pipe bedding thickness or pipe supports shall be removed. Rock shall be removed to 4 inches below the bottom of the pipe bearing elevation.
   3. Other: Any wood, refuse, waste, organic material, or other material which would adversely affect pipe support shall be removed. For bidding purposes, assume that 5% of all trench bottom area will have objectionable material as described in this paragraph.
   4. Replacement Material: Replace removed unsuitable material with “Utility Foundation Material” as specified under paragraph titled “General Backfill Materials”, or with bedding material specified for the piping to be placed in the trench.

C. Bottom Preparation: Bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of pipe (or other utility) after bedding placement, and proper slope of piping.

D. Depth: Trench shall be adequate to provide a minimum depth of cover required to meet connecting utilities; but minimum 1 foot of cover (unless indicated otherwise) OR as follows:
   1. Water Lines: 3.5 feet (or deeper if required by the AHJ); except that branch piping to fixtures within the building footprint shall have a minimum of 1 foot of cover.
   2. Other: As required to meet connecting utilities; but minimum 1 foot of cover (unless indicated otherwise).

3.04 BEDDING

A. Pipe Bedding: Provide even bedding placement along the entire length of the pipe to support pipe on a uniformly dense unyielding foundation, without load concentration at joint collars or bells. Bedding shall be installed and compacted prior to installing pipe. Bedding located beneath piping shall have minimum thickness specified in Part 2 of specifications, and be compacted to 90% maximum density. Recesses shall be excavated as necessary at each joint or coupling to eliminate point bearing and to allow uniform pipe support by the bedding material the entire pipe length. Haunching shall be installed in maximum 4 inch lifts, hand placed and carefully worked under the pipe haunches and then compacted to 90% maximum density. All adjustment to line and grade shall be made by scraping away or filling in with bedding material under the body of the pipe and not by blocking or wedging. Bedding disturbed by pipe movement, or by removal of shoring movement of a trench shield or box, shall be reconsolidated prior to backfill.

3.05 BACKFILLING

A. General: Provide backfill of all trenches and underground mechanical structures to grade. Provide adequate initial backfill to allow proper pressure tests, and inspections by AHJ and Architect/Engineer. Leave joints and couplings uncovered as necessary to discover pipe leaks. Do not conceal underground utilities until AHJ and Architect/Engineer have reviewed utilities.

B. Utility Zone Backfilling: Backfill shall be placed in loose layers and compacted to 90 percent maximum density. Backfill shall be placed in horizontal layers no more than 6-inches thick. Backfill shall be brought up simultaneously on each side of the utility to the top of the utility, and onto the specified height above the utility (see Part 2 of specifications). Backfill and compact in a manner to avoid damaging or disturbing the completed utility.

C. Pipe Trench Backfilling: Backfill above the pipe zone backfill shall be accomplished in such a manner that the pipe will not be shifted out of position nor damaged by impact or overloading. Where pipe is outside the building footprint, backfill shall be placed in horizontal layers no more than 6 inches thick and compacted to 95 percent maximum density. Where pipe is inside the building footprint, backfill shall be placed in horizontal layers no more than 6 inches thick and be compacted to 85 percent maximum density.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Air Balancing.

B. Report.

1.03 SUBMITTALS

A. General: Comply with Section 20 05 00.

B. Company: Submit name of Company proposed to do the balancing and sample balancing forms. Where the Company has not been pre-qualified, and substitutions are allowed after bidding (see Division 00 and 01), submit information regarding firm qualifications.

C. Personnel: Submit list of personnel that will be assigned to the project and their qualifications, and list of past projects.

D. Reports: Preliminary and final balancing reports.

1.04 REFERENCES

A. AABC-NS: Associated Air Balance Council, National Standards for Field Measurements and Instrumentation.

B. ASHRAE: Handbook of Fundamentals.

C. ACGIH-IV: American Conference of Governmental Industrial Hygienists, Industrial Ventilation, A Manual of Recommended Practice.

D. NEEB-PS: National Environmental Balancing Bureau Procedural Standard for Testing, Adjusting and Balancing Environmental Systems.

1.05 GENERAL REQUIREMENTS

A. General: Balancing shall be done by a company which specializes in this type of work and is totally independent and separate from the Company which has installed the systems to be balanced.

B. Balancers Qualifications:

1. General: Work of this Section shall be performed by balancing firms meeting the following and having prior approval from the Engineer:
    a. Professional Affiliation: Firm shall be an Associated Air Balance Council (AABC) member balancer or National Environmental Balancing Bureau (NEBB) certified balancer.
    b. Experience: Firm shall have satisfactorily completed the balancing work for at least 5 similar projects in the last 3 years. Similar is defined to mean: within 10% of the same quantity of units and air inlets/outlets, involve same type of systems, be the same type of facility (i.e. school, hospital, etc.). The lead field balancer (i.e. the individual who will be on site directing and participating in the balancing efforts) shall have at least 5 years of experience performing balancing work on similar projects.

c. References: Have five references for similar projects which have been completed in the last three years that will give a good or better performance rating. References shall be engineers, architects, or building owners. As part of the qualification process at least three of these references will be contacted and a rating obtained for the following: timeliness of work (i.e. able to complete work on schedule), cooperative nature of balancer's staff (i.e. ability to work well as a team with other project trades and professionals), overall quality of balancing work, quality of balancing report. Each item will be rated on a scale of 1 to 5 (5 being excellent), with the result averaged, score must be of 4 or better.

2. Pre-Qualified Balancers: As a convenience to the Contractor, the following balancing firms have been pre-qualified. This is not in any way intended to limit competition or prevent other firms from submitting qualifications, but is intended as an aid to Contractors by identifying firms that have been confirmed as meeting the qualification requirements.
   a. Neudorfer Engineers.
   b. Advanced Mechanical Services.
   c. Testing and Commissioning (TAC) Services.
   d. AccuABC.
3. Qualification Process: Firms not pre-qualified who desire to perform the balancing work shall submit a substitution request form in accordance with Contract Document requirements (reference Division 00 and 01). In addition to the information required on the substitution request form, submit: Company information, resumes of staff to be assigned, lists of projects, and references (with name of project, staff assigned to project, and contact name and phone number).

C. Balancing Issues: Notify the Engineer in writing of all problems or discrepancies between actual conditions and what design documents show as work proceeds.

D. Engineer's Authority: The Balancer shall be directly responsible to the Engineer and shall perform this work and make system adjustments as directed by the Engineer.

E. Lead Balancer: The Balancer shall assign an individual as "lead balancer" to work in the field to directly supervise the balancing work and field technicians. This lead field balancer shall have at least 5 years of experience performing balancing work on similar projects.

F. Added Site Visit: The Balancer shall include in his bid one extra site visit and associated time to access system readiness for balancing and resolution of balancing issues. Include added site visit and 8 hours of field balancing time, plus report amendment time to provide added balancing as directed by the Engineer. Such work may occur during the project's construction period or during the warranty period.

PART 2 PRODUCTS

2.01 GENERAL INSTRUMENTATION

A. General: Balancing equipment shall comply with Associated Air Balance Council recommendations for field measurement instrumentation.

B. Calibration: All measuring instruments shall be accurately calibrated and maintained in good working order. Calibration dates and certifications shall be available at Engineer's request.

C. Instruments: Shall be capable of:
1. Air velocity instruments, direct reading in feet per minute with 2% accuracy.
2. Static pressure instruments, direct reading in inches water gauge with 2% accuracy.
3. Tachometers, direct reading in revolutions per minute with 1/2% accuracy; or revolution counter accurate with 2 counts per 1,000.

4. Thermometers, direct reading in degrees Fahrenheit with 1/10 of a degree accuracy.

PART 3 EXECUTION

3.01 GENERAL

A. Workmanship: All measurements and adjustments shall be in accordance with AABC-NS, NEEB-PS, and ACGIH-IV and recognized best balancing procedures. Measurements and adjustments of equipment shall be executed in a manner consistent with the manufacturer's recommendations.

B. Flow Rates:
   1. General: All air and water systems shall be completely balanced and adjusted to provide the flow rates indicated (within tolerances indicated in this specification Section), and to produce an even heating and cooling effect and control response.
   2. Balancer Determined: Where flow rates have not been indicated the balancer shall determine such flow rates using acceptable practices in accordance with AABC-NS, NEEB-PS, and ASHRAE standards and submit the proposed flow rates to the Engineer for review.
   3. Confirmation: Prior to beginning balancing confirm any flow rate changes since design with the submittals and flow rates indicated therein, and with the Engineer to confirm changes made since design. Assume that new flow rates will be issued.

C. Controls: Consult and coordinate with the Control Contractor for the adjustment and setting of all control devices to allow for the balancing work, and for proper system operation and proper flow rates. Set all controls and valves as required to maintain design flow rates and temperatures as shown on the drawings. Make measurements and provide data to the Control Contractor to allow for proper control of items.

D. Comfort Adjustments: Make final adjustments for flow rates in order to optimize each space's comfort, including such considerations as temperature, drafts, noise, pressurization, and air changes. Where variances are made from design values, state reasons in report (e.g., "too noisy", "too drafty," etc.). All such variances are subject to approval by the Architect/Engineer.

E. Deficiency Reports: Submit deficiency reports where the work does not allow balancing to occur or balancing issues develop. Indicate date, system and equipment involved, location, description of deficiency, and related information to allow for diagnosing the problem. Provide suggestions for resolution where possible.

3.02 AIR BALANCING

A. Pre-check of System: Prior to beginning balancing, perform, as a minimum, the following:
   1. Verify that clean filters have been installed, that system is free from debris, and that all inlets/outlets are not obstructed.
   2. Check all fans and equipment to verify that proper start-up and system preparation has been done by the installing contractor.
   3. Check all door/window and similar building opening status to insure building is ready and proper pressurization can be obtained.
   4. Open all dampers to full flow position, check positions and operation of all motorized dampers to allow full system flows.
   5. Review controls and sequences of operation.

B. Tolerances: All air flow rates (supply, return, and exhaust) shall be adjusted to within plus 5 percent and minus 5 percent of the values shown in the contract documents, except that relative space-to-space pressure relationships shall always be maintained (e.g., restrooms shall be negative relative to other areas, general offices shall be positive, etc.).

C. Draft and Noise Adjustments: All diffusers, grilles, and registers shall be adjusted to minimize drafts and to eliminate objectionable noise.

D. Filters: Air balancing shall be done with new, clean air filters installed. Adjust air deliveries so that design quantities will be obtained when filters are half dirty. This condition shall be simulated by covering a portion of the filter area.

E. Fan Speeds and Drives:
   1. Adjust fan speeds and fan drives (adjustable sheaves) as required to produce design flow rates.
   2. Where new sheaves are required, calculate sizing of new sheave and coordinate requirements with the Division 23 Contractor for Division 23 Contractor to furnish the new sheave. Include bid costs for sheave replacements on 50% of belt driven fans.
   3. Adjust belts for proper tension.

F. Marking: Upon completion of flow readings and adjustments permanently mark the balanced position of all balancing valves by stamping the indicator plate of the valve.

G. Duct Traverse: Rectangular duct traverses shall measure the center of equal areas in the air flow stream, with centers not more than 6 inches apart. Round duct traverses shall measure at least 20 locations, with locations being the centers of equal annular area. Reference ACGIH Industrial Ventilation Manual.

H. One Open Run: Balance each branch run so that there is at least one wide open run; balance branches relative to one another so that at least one branch damper is wide open (except that where unique conditions exist, and the Engineer gives prior approval, one open damper on runs or branches is not required).

I. Data: Data to be measured/recorded and provided in report for all air handling systems and equipment:
   1. Floor plans clearly showing and identifying all diffusers, grilles, OA louvers, ducts and all other items where air flow rates were measured.
   2. Identify manufacturer, model number, size, and type of all air inlets/outlets.
   3. Initial, trial, and final air flow measurements for all diffusers, grilles, OA louvers, ducts, and all other items where air flow rates were measured.
   4. Design air flow rates and percentage final air flow rates are of design values.
   5. Final damper (or other balance device) final position (as a percentage of full open).
   6. The connected voltage and corresponding nameplate full load amps, and the initial and final amperages of all fan motors.
   7. Initial and final RPMs of all fans.
   8. Static pressures on inlet and outlet of all fans.
   9. Fan initial and final CFMs.
   10. Outdoor air CFMs (record minimum and maximum values).
   11. Entering and leaving air temperatures across coils with coils operating at 100% capacity.
   12. Static pressure drop across each filter bank and coil.
   13. Final position of any speed controls (as percent of full).
   14. In addition to data noted elsewhere, provide the following for all equipment which are part of balanced systems:
      a. Equipment name and number (as used on drawings).
      b. Service.
      c. Equipment manufacturer and model number.
      d. Sheave and belt sizes (where applicable).

e. Filters sizes and quantities (where applicable).
f. Motor manufacturer and complete nameplate data.
g. Design operating conditions.
h. Actual operating conditions (flows, pressure drops, rpm, etc.).

3.03 BALANCING REPORT

A. General: A balancing report shall be submitted as specified herein, documenting all balancing procedures and measurements.

B. Report Organization: The report shall be divided into logical sections consistent with the building or system layout (i.e. by floors, building wings, air handling units, or other convenient way). Tabulate data separately for each system. Describe balancing method used for each system.

C. Preliminary Report: Two preliminary review copies of the balancing report shall be submitted to the Architect/Engineer when the balancing work is 90% complete (or as near 90% complete as possible due to uncompleted work of other trades). In addition to containing all the information required of the final report, the preliminary report shall contain a list of all the work required of other trades in order to allow the balancing work to be completed. The Architect/Engineer will review the preliminary report and inform the Contractor of any additional items or revisions required for the final report. Preliminary reports may be omitted where the Architect/Engineer grants approval.

D. Final Report: Shall be included in the Operation and Maintenance Manual. Submit reports to Contractor for inclusion in Manuals (or, when manuals have been already sent to Engineer, send report to Engineer who will insert report into Manual). Provide number of reports as required to match quantity of O&M Manuals, but in no case less than five.

E. Format: 8-1/2" x 11" size, neat, clean copies, drawings accordion folded. Report shall be typed, shall have a title page, table of contents, and divider sheets with identification tabs between sections. Information shall be placed in a three hole notebook, with the front cover labeled with the name of the Job, Owner, Architect/Engineer, Balancing Contractor, and Report Date.

F. Electronic Copy: Provide copy of reports in *.pdf format; submit final report with closeout documents per Divisions 00 and 01. Provide two CD’s with each having an electronic copy of the report in pdf file format. Label CD neatly same report labeling. Provide electronic pdf files to others for inclusion in electronic record documents.

G. General Balancing Information Required:
1. At the beginning of the report, include a summary of problems encountered, deviations from design, remaining problems, recommendations, and comments.
2. List of instruments used in making the measurements and instrument calibration data.
3. Names of personnel performing measurements.
4. Explanation of procedures used in making measurements and balancing each system.
5. List of all correction factors used for all diffusers, grilles, valves, venturi meters, and any other correction factors used.
6. Areas where difficulties were encountered in obtaining design flow rates, or where unstable operating conditions may exist.
7. Note any parts of the system where objectionable drafts or noises may be present and efforts made to eliminate same and why they may still be present.
8. Note where variances from design values occur; explain why.
9. All specified measurements, balancing data, any additional recorded data, and observations.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Duct Insulation.

B. Pipe Insulation.

C. Equipment and Specialties Insulation.

1.03 DEFINITIONS

A. R: Thermal resistance of insulation, in units of hr-sf-deg F/Btu.

B. Rainleader Piping: Any piping or conduit that is used to carry rain water, including overflow drain piping, that is located within the building or enclosed by any building construction.

C. Subject to Damage: Items installed exposed less than 8 feet above the walking surface (i.e. floor, platform, roof, grade, etc.) adjacent to the item.

D. Cold Surfaces: Surfaces that will have operating temperatures below the temperature of the surrounding air by at least 5 deg F or more; includes chilled water piping, cooling condensate piping, air conditioning ductwork, outdoor air ductwork, and similar systems. Surfaces shall be considered a cold surface unless specifically indicated otherwise.

1.04 QUALITY ASSURANCE

A. All insulation and materials shall have a fire hazard rating not to exceed 25 for flame spread and 50 for smoke development, as tested by ASTM E 84, NFPA 255, and UL 723.

1.05 SUBMITTALS

A. General: Comply with Section 20 05 00.

B. Product Data: Provide product data on all insulation materials to be used. Indicate thicknesses to be used.

1.06 GENERAL REQUIREMENTS

A. Code Compliance: Contractor shall insulate all systems with the materials and thicknesses as required by code, but in no case shall the insulation be less than that specified herein. In some cases the specified insulation exceeds code, and shall be provided as specified. Not all systems requiring insulation by code are specified, but shall be provided with insulation where required by code.

B. Insulation at Hangers: Insulation shall be continuous through hangers on all insulated systems (except ductwork). Inserts at hangers are specified in Section 20 05 29 and are considered as part of the hanger and support system. Inserts are required to be installed at the time of pipe installation and are intended to be installed by the Contractor installing the pipe hangers/supports. See Section 20 05 29.

1.07 REFERENCES

A. ASTM A 653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

B. ASTM C 411: Standard Test method for Hot-Surface Performance of High Temperature Thermal Insulation.

C. ASTM C 547: Standard Specification for Mineral Fiber Pipe Insulation.

D. ASTM C 1136: Standard Specifications for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

E. ASTM C 1290: Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

F. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.

G. NCIIS: National Commercial & Industrial Insulation Standards, published by Midwest Insulation Contractors Association, 5th Edition.

H. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials.

I. UL 723: Tests for Surface Burning of Building Materials.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Paragraph Part 2.01, Acceptable Manufacturers.

B. Insulation: Johns Manville, Armacell, Owens-Corning, Knauf, Rubatex, Aeroflex, Pittsburgh Corning, GLT, Halstead, Gilsulate, Manson.

C. Accessories: Johns Manville, Armacell, Owens-Corning, Knauf, Rubatex, Aeroflex, Pittsburgh Corning, GLT, Halstead, Duro Dyne, Gustin Bacon, Childers, RPR, Tee Cee, Lewco Specialty Products, JPS, Buckaroos, Manson.

2.02 DUCT INSULATION

A. Type: Flexible blanket type, constructed of inorganic glass fibers bonded by a thermosetting resin, complying with ASTM C 1290, Type III. Johns Manville “Microlite” (or approved).

B. Jacket: FSK type, vapor proof, consisting of an aluminum foil cover reinforced with glass fiber mesh, and laminated to kraft. Water vapor permeance shall not exceed 0.05 perms. Provide with joint sealing tape, minimum 2 inches wide, constructed of jacket material with adhesive to seal all joints.

C. Thermal Conductivity: Shall not exceed 0.27 Btu-in/hr-sq ft-deg F at 75 deg F.

D. Operating Limits: 40 degrees F to 250 deg F.

E. Duct Insulation Thickness:

1. General: Provide insulation densities and thicknesses to achieve the R values cited below. R values are for the insulation only, in their installed thickness, considering installed duct wrap stretch and in accordance with code.
2. Lining: Where ducts have internal lining, the insulating properties of the lining may be credited toward meeting the required insulation R value; use R-3.65 per inch of installed liner.

3. Supply Air Ductwork:
   a. Inside Building and Within Building's Thermal Envelope: R-3.3 (except where ran exposed in conditioned spaces, no insulation is required).
   b. Inside Building but Not Within Building's Thermal Envelope: R-7.3.
4. Return Air Ductwork:
   a. Inside Building and Within Building's Thermal Envelope: No insulation required; except where duct contains air that may vary by 10 deg F or more from the space the duct passes through, R-3.3 insulation shall be provided.
   b. Inside Building but Not Within Building's Thermal Envelope: R-7.3.
5. Exhaust, Relief, and Special Ductwork:
   a. Inside Building and Within Building's Thermal Envelope:
      1) Temperature of Air in Duct within 10 Deg F of Temperature of Air in Spaces Duct Passes Through: No insulation required except ductwork from the system's backdraft damper (or motorized damper) to outside the building shall be insulated same as required for the building envelope.
      2) Temperature of Air in Duct more than 10 Deg F Different from temperature of Air in Spaces Duct Passes Through: R-8.3; except ductwork from the system's backdraft damper (or motorized damper) to outside the building shall be insulated same as required for the building envelope (but no less than R-8.3).
   b. Inside Building but Not Within Building's Thermal Envelope: R-8.3.

2.03 PIPE INSULATION

A. Glass Fiber:
   1. Type: Rigid molded type, constructed of glass fibers bonded by a thermosetting resin, complying with ASTM C 547 Type I. Insulation factory molded to match pipe size applied to. Johns Manville "Micro-Lok" (or approved).
   2. Jacket: ASJ type, vapor proof, consisting of a white kraft paper cover reinforced with glass fiber and bonded to aluminum foil, with longitudinal self sealing closure system. Provide with butt strips constructed of jacket material with adhesive to seal all joints. Water vapor permeance shall not exceed 0.02 perms.
   3. Thermal Conductivity: Shall not exceed 0.24 Btu-in/ hr-sq ft-deg F at 75 deg F.
   4. Operating Temperatures: 0 deg F to 850 deg F.

B. Elastomeric Insulation:
   1. Type: Flexible cellular elastomeric insulation, factory formed to match pipe sizes applied to, complying with ASTM C 534, Type 1. Armacell "AP/Armaflex SS" (or approved).
   2. Thermal Conductivity: Shall not exceed 0.27 Btu-in/ hr-sq ft-deg F at 75 deg F.
   3. Water Vapor Transmission: Water vapor permeance shall not exceed 0.08 perms.
   4. Operating Temperatures: -200 deg F to 220 deg F; shall be able to withstand 250 deg F temperatures for 96 hours per ASTM C 411 without damage or deformation.
   5. Weather Protection: Where installed outdoors provide with metal jacketing to protect from UV and weather exposure.

C. Pipe Fittings: Shall be covered using any one of the following methods of the Contractor's choice:
   1. Prefabricated segments of pipe insulation of same materials and thickness as the adjoining pipe insulation, formed to match pipe fitting.
   2. Pre-cut fiberglass insulation and pre-molded high impact, gloss white, UV resistant, minimum 20 mil thick, PVC covers suitable for the pipe size and insulation thickness application, PVC cover shall be Johns Manville "Zeston 2000 PVC" (or approved).

3. Insulating plastic cement brought up the full height of the adjacent covering.
4. Except, where colored PVC jacketing is applied to piping, fittings shall use PVC covers of the same thickness and color as the PVC jacketing specified for the piping.

D. PVC Jacket: Pre-molded 30 mil thick PVC jacket; size and shape to match piping and fittings applied to. Johns Manville “Zeston Series 2000" (or approved). Provide in white color.

E. Pipe Insulation Types:
1. Aboveground-Inside Building: Other Systems: Glass fiber.
2. Aboveground-Outside Building: Same as specified above, with metal jacket.
3. Metal and PVC Jacketing: See “Part 3 - Execution”.

F. Pipe Insulation Thickness:
1. General: Provide minimum piping insulation thickness indicated, in inches.

INSULATION THICKNESS (INCHES)

Nominal Pipe Diameter (Inches)					
Fluid Design Operating Range, deg F	<1	1< to 1-1/2	>1-1/2 to <4	4 to <8	≥8
Above 350	4.5	5.0	5.0	5.0	5.0
251 - 350	3.0	4.0	4.5	4.5	4.5
201 - 250	2.5	2.5	2.5	3.0	3.0
141 - 200	1.5	1.5	2.0	2.0	2.0
61 - 140	1.0	1.0	1.5	1.5	1.5
40 - 60	0.5	0.5	1.0	1.0	1.0
Below 40	0.5	1.0	1.0	1.0	1.5

2. Varying Temperatures: Where a system operates over temperature ranges calling for different insulation thicknesses, the thicker insulation requirements shall be met.
3. Cold Water: Cold water piping shall be considered to operate at 56 deg F (unless noted otherwise).

2.04 EQUIPMENT AND SPECIALTIES INSULATION

A. Flexible Glass Fiber:
1. Type: Flexible blanket insulation, constructed of inorganic glass fibers bonded by a thermosetting resin, complying with ASTM C 553, Type III. Johns Manville “812 Spin-Glas” (or approved).
2. Jacket: FSK type, vapor proof, consisting of an aluminum foil cover reinforced with glass fiber mesh, and laminated to kraft. Water vapor permeance shall not exceed 0.05 perms. Provide with joint sealing tape constructed of jacket material with adhesive to seal all joints.
3. Thermal Conductivity: Shall not exceed 0.24 Btu-in/ hr-sq ft-deg F at 75 deg F.
4. Operating Temperature Limits: 40 deg F to 450 deg F.
5. Density: 1.5 lb/cu ft.

B. Elastomeric:
1. Type: Flexible cellular elastomeric insulation, complying with ASTM C 534, Type II.
2. Thermal Conductivity: Shall not exceed 0.30 Btu-in/ hr-sq ft-deg F at 75 deg F.
3. Water Vapor Transmission: Water vapor permeance shall not exceed 0.08 perms.
4. Operating Temperatures: -200 deg F to 220 deg F; shall be able to withstand 250 deg F temperatures for 96 hours per ASTM C 411 with damage or deformation.

5. Weather Protection: Where installed outdoors provide with metal jacketing to protect from UV and weather exposure.

C. Equipment and Specialties Insulation Types and Thickness:
   1. Unless a specific type of insulation is specified or noted, any of the insulation materials specified in this specification section may be used provided such application is in conformance with NCIIS.
   2. Insulation Thickness: Insulation thickness shall be the same as that specified for the piping or ductwork connected to the item, or as specified for the system the item is installed in (unless noted otherwise). Insulation thickness shall in no case be less than 1 inch thick.

2.05 ACCESSORIES

A. Adhesive, Caulks, Mastics, and Coatings: As recommended by insulation material manufacturer and suited for the application.

B. Bands: 1/2-inch wide, of stainless steel, galvanized steel, or aluminum construction, to match with materials used with.

C. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length shall be as required for insulation thickness used with. Welded pin holding capacity 100 lb, for direct pull perpendicular to the attached surface. Style and type to suit application.

D. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness used with. Adhesive as recommended by the anchor pin manufacturer as appropriate for surface temperatures and materials used with, and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface. Style and type to suit application.

PART 3 EXECUTION

3.01 GENERAL

A. Pre-Insulation Review: No covering materials shall be applied until systems to be covered have had all tests satisfactorily completed, have had all required inspections, and have been satisfactorily reviewed by the Architect-Engineer. All systems shall be examined by the Contractor to confirm cleanliness and other conditions are appropriate to allow for insulation installation.

B. Insulation Work Review: No insulated items shall be concealed in the building structure or buried until the insulation work has been satisfactorily reviewed by the Architect-Engineer, and has had all required inspections.

C. Standards: Materials shall be installed in accordance with manufacturer's written instructions, NCIIS, and shall comply with materials and methods specified herein. The more stringent requirements govern.

D. Joints/Seams: Joints shall be staggered on multi layer insulation. Locate seams and joints in least visible location.

E. Insulation Protection: Insulation shall be kept clean and dry and shall be protected from dirt, damage, and moisture. Insulation that becomes dirty, damaged, or wet and cannot be restored to like new condition will be rejected, and shall immediately be removed from the jobsite.

F. Insulation Interruptions: Insulation shall be neatly finished at all supports, protrusions and interruptions. Provide adhesive and tape seal to maintain vapor barrier integrity.

G. Equipment and Floor Protection: Cover existing equipment and finished floors to protect such items from insulation fiber and dust. Keep all such existing areas in a "broom clean" condition at the end of each day. Take precautions in these areas to prevent glass fiber and insulation dust from entering ventilation systems or areas adjacent to the work.

H. Glass Fiber Insulation - General:
   1. Finish all insulation ends with joint sealing tape or vapor barrier mastic, no raw edges allowed.
   2. Joints: Tightly butt adjacent insulation sections together without any voids. Provide overlap of jacket material over all joints.

I. Items to Be Insulated: Provide insulation on all ductwork, all piping, all items installed in these duct and piping systems, all air and liquid energy conveying systems and components, all air and liquid energy storage, all equipment, and all energy consuming devices, except where such insulation has been specifically excluded.

J. Items Excluded from Being Insulated:
   1. Sanitary sewer drain lines (except traps at handicap accessible fixtures).
   2. Stops and risers at plumbing fixtures (except at handicap accessible fixtures).
   3. Factory insulated water heaters (except for base on electric water heaters).
   4. Electric motors.
   5. Fans.
   6. Factory insulated or factory lined HVAC, AHU, and AC units.
   7. Pumps handling hot water.
   8. Relief Valves and associated drain piping.
   9. Hose bibbs (except where used as drains hot water systems).
   10. Fuel piping.
   11. Underground cold water piping and associated underground items.

3.02 DUCT INSULATION INSTALLATION

A. Types and Thickness: Insulate all ducts with insulation type and thickness (to provide the required R value) as specified in “Part 2 - Products”.

B. General: Insulation shall be firmly butted at all joints. All longitudinal seams for flexible insulation shall overlap a minimum of 2 inches. All joints and seams shall be finished with appropriate joint sealing tape. Installation shall provide a continuous sealed vapor barrier over all surfaces; seal all jacket penetrations with vapor barrier mastic or vapor barrier jacket tape.

C. Attachment: For rectangular ducts over 24 inches wide, duct insulation shall be additionally secured to the bottom of the ductwork with mechanical fasteners on 18 inch centers to reduce sagging. Washers shall be applied without compressing the insulation. Protruding ends or fasteners shall be cut off flush after washers are installed. All seams, joints, penetrations, and damage to the facing shall be sealed with joint sealing tape or vapor retardant mastic or appropriate joint sealing tape.

3.03 PIPE INSULATION INSTALLATION

A. Types and Thickness: Insulate all piping with insulation type and thickness as specified in “Part 2 - Products”. All piping shall be insulated except where specifically excluded.

B. General: All ends shall be firmly butted together and secured with joint sealing tape. All jacket laps and joint sealing tape shall be secured with outward clinch staples at 4 inch spacing, or by use of a suitable adhesive. Installation shall provide a continuous sealed vapor barrier over all surfaces; seal all jacket penetrations with vapor barrier mastic or vapor barrier jacket tape.

C. Elastomeric Pipe Insulation: Install with seams and joints sealed with rubberized contact adhesive. Insulation with pre-applied adhesive is not permitted. A brush coating of adhesive shall be applied to both butt ends to be joined and to both split surfaces to be sealed. Adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Provide added tape wrap around insulation to ensure seam and joint closure. Insulation that can be pulled apart one hour (or more) after adhesive installation shall be replaced.

D. Pipe Hangers: Provide insulation tight up to pre-insulated pipe supports at pipe hangers, seal all joints with joint sealing tape. Pre-insulated pipe supports are specified in Section 20 05 29.

E. Pipe Sleeves: Run insulation continuous full size through sleeve. Coordinate work with fire seals and confirm fire seal system is approved for use with insulated pipes; see Section 20 05 30.

3.04 EQUIPMENT AND SPECIALTIES INSTALLATION

A. Types and Thickness: All equipment and items installed in insulated duct and piping systems shall be insulated except where specifically noted not to be; reference paragraph 3.01. Insulation type and thickness shall be as specified in “Part 2 - Products”.

B. General: Apply insulation as close as possible to equipment by grooving, scoring, and beveling as necessary. As required, secure insulation to equipment with studs, pins, clips, adhesive, wires or bands. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. Comply with NCIIS.

C. Removable: All equipment and specialties where access is required for maintenance, repair, service, or cleaning shall have insulation installed so that it can be easily removed and reinstalled without being damaged and without requiring new insulation. Removable insulation shall completely cover the item being insulated with an overlap over adjacent insulation to cover all joints. Insulation on cold surfaces shall provide a sealed vapor barrier so that no surfaces are exposed to ambient air and so that no condensation can occur; overlap enclosure ends minimum 2-inches.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Commissioning of Mechanical Systems.

B. Documentation.

1.03 SUBMITTALS

A. General: Comply with Section 20 05 00.

B. Qualifications: Submit qualifications of the firm proposed to perform the commissioning work and for the individuals that will be assigned.

C. Commissioning Data:
   1. Commissioning plan.
   2. Commissioning preliminary report.
   3. Commissioning final report.

1.04 GENERAL REQUIREMENTS

A. General: Commissioning shall be done by a Company which specializes in this work and independent and separate from the Companies installing the systems to be commissioned.

B. Company Experience: The Company providing the commissioning work shall be experienced in commissioning HVAC control systems, and have commissioned at least five similar projects in the last three years. Company shall be certified for such work by AABC, NEBB, AEE or the BCA.

C. Individual Experience: The individuals performing the commissioning work shall have at least five years experience in commissioning, with the individual in the field in charge or the work having commissioned at least five similar projects in the last three years.

D. Deferred Test: Tests may be deferred to allow for proper climatic or other conditions.

1.05 REFERENCES

A. AABC: Associated Air Balance Council.

B. AEE: Association of Energy Engineers.

C. BCA: Building Commissioning Association.

D. NEBB: National Environmental Balancing Bureau.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. General: Provide commissioning as required by code and as specified herein.

B. Building Occupancy: Building or portions thereof, required by code to be commissioned, shall not be considered ready for occupancy until such time that the Engineer and building official determine that the preliminary commissioning report required by this Section has been completed.

3.02 NON-HVAC SYSTEMS

A. General: All automatically controlled systems for which energy consumption, performance, or mode of operation are regulated by Code, shall be tested to ensure that control devices, equipment and systems are calibrated, adjusted and operate in accord with approved plans and specifications.

B. Sequences: Sequences of operation shall be functionally tested to ensure they operate in accord with plans and specification.

3.03 HVAC SYSTEMS

A. General: HVAC equipment and HVAC control systems shall be tested to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved plans and specifications.

B. Sequences: Sequences of operation shall be functionally tested to ensure they operate in accordance with approved plans and specifications.

C. Conditions: Testing shall affirm operation during actual or simulated winter and summer design conditions and during full outside air conditions.

D. HVAC Equipment: Equipment functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications such that operation, function, and maintenance serviceability for each of the commissioned systems is confirmed. Testing shall include all modes and sequence of operation, including under full-load, part-load and the following emergency conditions:

1. All modes as described in the sequence of operation.
2. Redundant or automatic back-up mode.
3. Performance of alarms.
4. Mode of operation upon a loss of power and restoration of power.

E. HVAC Controls: HVAC control systems shall be tested to document that control devices, components, equipment, and systems are calibrated, adjusted, and operate in accordance with approved plans and specifications. Sequence of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.

F. Economizers: Air economizers shall undergo a functional test to determine that they operate in accordance with manufacturer's specifications.

3.04 DOCUMENTATION

A. Format:

1. Hard Copy: Provide reports in 8-1/2 x 11 format, in 3 ring notebooks, with labeled cover and spine, clean legible, and logically organized with table of contents, divider tabs, and names of companies involved in the project, commissioning company name, commissioning personnel, and contact information. Provide 3 copies per Divisions 00 and 01.
2. Electronic: Provide copy in *.pdf format; submit with closeout documents per Divisions 00 and 01.

B. Test Plan: Prepare a written commissioning test plan and submit for approval prior to beginning commissioning work. Test plan to include:
1. Equipment and systems to be tested.
2. Roles and responsibilities of individuals performing the commissioning and of others involved in the project.
3. Functional test procedures and forms.
4. Conditions under which the test shall be performed (for example, winter design conditions, full outside air, etc.).
5. Expected systems' response or acceptance criteria for each procedure.
6. Time schedule for performance of the work; including any deferred tests.
7. Forms as required by the WSEC or AHJ.

C. Preliminary Commissioning Report:
1. General: A preliminary report shall be issued to identify issues preventing the commissioning work from being completed. If all commissioning work can be fully completed and the final report completed, a preliminary report is not required.
2. Report: Compile all system and commissioning data; including all reviews, inspections, test procedures, and tests. Report shall include field notes of commissioning activities, equipment and system data, test procedures, tests performed, actual results as compared to expected (or specified) results, WSEC and any AHJ required commissioning forms (completed to the extent possible).
3. Items to Complete: The preliminary report shall identify items needed in order to complete the commissioning, including:
a. Deficiencies found during testing required by this Section, which have not been corrected at the time of report preparation.
b. Deferred tests which cannot be performed at the time of report preparation due to climatic (or other) conditions.
c. Climate (or other) conditions required for performance of the deferred tests, and the anticipated date of each deferred test.
d. Proposed schedule for completion of report.

D. Final Commissioning Report: Complete all commissioning work not previously completed and included in the preliminary report. Provide a complete final report with all systems and commissioning data; including test plan, all reviews, inspections, test procedures, tests, and results. Final report shall include all documentation required for the preliminary report and documentation regarding resolution of previous coted deficiencies.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Sprinkler System Design.

B. Piping.

C. Sprinkler Heads.

D. Owner Instruction.

1.03 QUALITY ASSURANCE

A. General: Comply with 20 05 00 requirements.

B. Listing: All materials and equipment shall be UL listed and FM approved for the application.

C. Latest Design: Products shall be of the manufacturer's latest design.

D. Code and AHJ Compliance: Products and installation shall comply with code and Authority Having Jurisdiction (AHJ) requirements. Contractor is responsible to review and be familiar with code and local AHJ requirements. Products submitted are represented by the Contractor as complying with code and AHJ requirements.

E. Exceed Code: The Contract Documents indicate items in excess of code requirements; in all such cases the work shall be done so that code requirements are exceeded as indicated. Such work may include coverage of areas not strictly required by code, painting, concealing of piping, access provisions for system inspections, oversized mains to accommodate future expansion, etc.

1.04 SUBMITTALS

A. General: Comply with Section 20 05 00.

B. Shop Drawings:
   1. Submit shop drawings of revised sprinkler system to Architect/Engineer for review; label these as "Preliminary – Not for AHJ Review". After incorporating or satisfactorily resolving Architect/Engineer review comments, submit shop drawings to AHJ for approval; label these as "AHJ Review Set"; at same time submit informational copy to the Architect/Engineer.
   2. Shop drawings shall include: riser detail, pipe support details, heights of piping above finished floor, room names and numbers, building grid lines, and building sections to give an overall representation of pipe routing.
   3. Shop drawings shall show head locations on reflected ceiling plans; use shop drawings from ceiling installer for ceiling layout; where these drawings are not available use information in the Contract Documents to develop a reflected ceiling plans.
   4. Shop Drawings shall show ductwork along with piping. Use shop drawings from ductwork installer for ductwork layout; where these drawings are not available use information in the Contract Documents.

C. Product Data: Submit information on all products to be used; include evidence of product UL listing and FM approval. Submit proposed labeling and signage.

D. Calculations: Submit all system calculations showing compliance with NFPA and AHJ requirements.

E. Review Impacts: Architect/Engineer's review may involve changes to Contractor's design in order to comply with the Contract Documents including aesthetic issues. These changes may be substantial enough to affect drawings and calculations submitted to the AHJ and requiring a resubmittal. Contractor shall assume at least one re-submittal to the AHJ will be required and shall pay all required AHJ re-submittal and AHJ re-review fees.

1.05 GENERAL REQUIREMENTS

A. Experience: All fire sprinkler design shall be performed by a Contractor thoroughly familiar with and knowledgeable of NFPA 13, NFPA 24, local AHJ requirements, and fire sprinkler system design and installation. By virtue of submitting a bid, the Contractor is acknowledging that he does in fact have such knowledge; and all work provided will fully comply with all the requirements of these specifications. The fire sprinkler Contractor shall be qualified, as required by the AHJ to design and install all parts of the fire sprinkler system. All portions of underground fire sprinkler piping shall be installed by a licensed fire sprinkler contractor, or by a level U certified plumbing contractor, as issued by the State's Fire Marshal's office.

B. Professional Stamp: All fire sprinkler design drawings and calculations shall be prepared by and stamped by a licensed fire sprinkler professional as required by the AHJ.

C. Design: System shall be Contractor designed and approval by both the Fire Marshal and Architect/Engineer. System design shall comply with Contract Documents regarding particular system configuration as may be specified or noted (i.e. routing of mains, head locations, etc.).

D. System Description: Wet pipe or dry pipe fire sprinkler system (as indicated on plans) provided for each building with a dry pipe system serving all areas subject to freezing (dry type heads off wet system are acceptable for limited coverage areas). Buildings/ areas indicated shall be dry type as noted. All spaces within sprinklered areas shall be sprinklered as required by the AHJ. Revise existing system to suit revised floor plan. Replace all existing sprinkler heads with new.

E. Special Design Areas: Various portions of the building's fire sprinkler system require special design effort and coordination; including but not limited to: multiple design layouts, multiple calculations for these layouts, multiple meetings with code officials, multiple meetings with various contractors, multiple meetings with members of the design team, added coordination among trades, coordination with the AHJ, and coordination with the design team. The Contractor shall include in his bid costs for such special design and installation work.

1.06 REFERENCES

A. FM-AG: FM Global Approval Guide.

B. NFPA 13: Standard for the Installation of Sprinkler Systems.

C. UL-FPD: Underwriters Laboratories Fire Protection Equipment Directory.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. General: All products shall comply with Section 20 05 00, Paragraph 2.01, Acceptable Manufacturers.

B. Pipe and Fittings: Contractor selected; complying with NFPA 13 and AHJ requirements.

C. Valves: Ames, Febco, Watts, Crane, Grinnell, Potter-Roemer, Viking, Gem, Victaulic, Nibco, Stockham, and manufacturers listed for “Sprinkler System Components”.

D. Sprinkler System Components: Reliable, Viking, Potter-Roemer, Gem, Star, Victaulic, Tyco.

2.02 PIPE AND PIPE FITTINGS

A. Aboveground Pipe and Fittings: Pipe shall be steel or copper; in accordance with NFPA 13. Fittings shall be suitable for 175 psi working pressure, and shall be cast iron or malleable iron screwed, grooved, welded, or soldered; in accordance with NFPA 13. Pipe and fittings shall have a CRR of 1.0 or better. Pipe and fittings ran outside and exposed to the outdoors shall be galvanized type. Flexible braided steel piping serving individual heads may be used where acceptable to the AHJ, and such piping is FM approved and UL listed for the application.

2.03 VALVES

A. Valves: Rated for 175 psi water working pressure, UL listed and FM approved, complying with NFPA 13, having configuration and accessories to suit application.

2.04 ALARM VALVES--WET PIPE

A. Alarm valve shall be UL listed and FM approved for use as an alarm valve in a wet pipe fire sprinkler system, same size as riser (unless noted otherwise).

B. Alarm valve shall be complete with pressure gauge, main drain valve, alarm switch, and all other accessories to provide a complete alarm valve assembly as required to function in accordance with NFPA standards, and as required by the AHJ.

2.05 ALARM VALVES--DRY PIPE

A. Alarm valve shall be UL listed and FM approved for use as an alarm valve in a dry pipe fire sprinkler system, size as selected by Contractor.

B. Alarm valve shall be complete with accelerator, pressure gauges, main drain valve, pressure alarm switch, alarm test valving, priming connections, drain lines/drain cup, connections for water motor alarm, check and isolation valves for air line connection, air line relief valve and all other accessories to provide a complete alarm valve assembly as required to function in accordance with NFPA standards, and as required by the AHJ.

2.06 SPRINKLER HEADS

A. Wet Type - Finished Areas:
   1. Pendant: Shall be low profile, glass bulb type, with temperature rating to suit application and factory chrome plated finish. Where installed through ceiling, provide with escutcheons, two piece adjustable recessed type, with factory chrome plated finish to match sprinkler heads. Quick response type.
   2. Upright: Shall be glass bulb type, with temperature rating to suit application, and factory chrome plated finish. Quick response type.
   3. Sidewall: Shall be glass bulb or fusible solder type, with temperature rating to suit application, and factory chrome plated finish. Quick response type.
   4. Holding Cells: Institutional “prison” type.

B. Wet Type - Unfinished Areas: Link/lever type or glass-bulb type, with natural bronze or chrome plated finish, temperature rating to suit application. Quick response type.

C. Sprinkler Guards: Hard-wire cage sprinkler guard, designed to protect sprinkler from mechanical damage, with chrome plated finish. Where used on exposed heads, guards shall

be type that clamp to pipe; where used on recessed heads, guards shall be surface anchor type having substantial attachments to material surrounding the head (soffit plywood, etc.); provide 2x backing as needed. Provide custom fabricated guards/attachments as required.

D. Sprinkler heads shall be upright, pendant or sidewall type as required to suit application.

E. Extended Coverage Heads: Provide as necessary to allow complete coverage of all areas.

2.07 ACCESSORIES

A. Hangers/Supports: See Section 20 05 29.

B. Sleeves Seals: See Section 20 05 30.

C. Labeling:
   1. General: See Section 20 05 00 for labeling of piping, valves, equipment, concealed items, and similar items.
   2. Design Basis: Provide label identifying hydraulic basis of design and other design parameters, fabricated of material as required by the AHJ, with lettering type and information as required by the AHJ.
   3. Other: Provide additional labels as required by AHJ, fabricated of material as required by the AHJ, with lettering type and information as required by the AHJ.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Installation of all equipment shall be performed by a Contractor specializing in this work and subject to Owner and Fire Marshal approval. Install all items in accordance with code, manufacturers' recommendations, and best construction practices.

B. Pipe Routing:
   1. Select pipe routing that maintains full personnel access to building equipment and systems, without requiring stepping over or bending down to cross sprinkler piping. Follow specific pipe routing requirements of the Contract Documents as indicated. Piping shall run parallel to building structure in a neat, workmanlike manner.
   2. All piping shall be run concealed in ceiling space, attic space, pipe shafts, soffits, etc. where possible. Piping may only be exposed with Engineers approval and shall be painted as directed by the Architect/Engineer. Where piping must run exposed, it shall be ran in as unobtrusive fashion as possible, in lines parallel to major building features, as high as possible, and as directed by the Architect/Engineer.
   3. Provide all necessary drilling of beams, trusses, etc; reference Section 20 05 00 for cutting requirements; structural Engineers approval is required prior to any such cutting or drilling.

C. Escutcheons: Provide chrome plated escutcheon plates at exposed pipe penetrations of all ceilings, floors and walls.

D. Conflict Prevention:
   1. Review all building and system plans carefully and arrange the fire sprinkler work to avoid interferences and conflicts with other trades. Discuss and coordinate proposed sprinkler routing with other trades. The fire sprinkler system has the lowest priority of all building systems and is required to accommodate the space requirements of other systems.
   2. If piping routes are not properly coordinated with other trades and structures, rerouting and possible re-sizing will be required as directed by the Architect/Engineer. Offset, crossover and otherwise route piping to install system in available space.

E. System Drainage: Special care shall be taken to ensure that entire sprinkler system is drainable in accordance with code. Provide drain valves as required (with labels) to allow for drainage; valves shall be concealed (with access doors) where possible; provide valves with provisions (male pipe nipple) for attaching temporary drain lines (where needed). Extend main drain(s) and 1 inch inspector's test connections to outside for drainage.

F. Labeling: Provide labeling of items per Section 20 05 00. Provide additional labeling of items per AHJ requirements. All drain valves, alarm bells, and risers shall be labeled to clearly indicate purpose and area served. Label riser with hydraulic basis of design information. All piping shall be labeled per Section 20 05 00.

G. Sprinkler Heads: Heads shall be centered in ceiling panels. Where “scored” ceiling panels are used, heads shall be located to be centered in the flat portion of the tile between “scores”.

H. Head Protection: Provide wire cage protectors for heads susceptible to damage (this includes all heads in mechanical loft areas with sprinkler heads 7 feet or less above walking surface, all gym heads, outside soffit heads below 9 feet, and similar areas).

I. Hangers and Supports: Shall comply with NFPA 13 and Section 20 05 29. See also structural drawings for added limitations/requirements of supports and attachments to structure.

J. Room Signage: Rooms containing fire suppression risers, system control valves, and other major fire suppression components shall have signage on the outside of the door to the room. Verify AHJ requirements and locations prior to ordering.

3.02 SYSTEM DESIGN

A. General: System shall be Contractor designed in accordance with NFPA 13, AHJ requirements, and additional requirements as cited in the Contract Documents. Design shall be based on designated occupancy, storage configurations, commodity types, and related parameters. Where insufficient data is available request clarification prior to bidding.

B. Hydraulically Designed:

1. General: Base system design on hydraulic calculations in accordance with recognized engineering practices and standards, acceptable to the AHJ and Engineer. Calculations shall use approved water flow test data on the water supply main serving the fire protection system. Such test data must meet the approval of the AHJ and the Engineer.
2. Water Flow Data: Obtain updated water flow data (including new water tests) and pay all associated test fees or charges. Design and calculations shall include complete system, including water main to building, and extending as far back into the local utility systems (i.e. to reservoirs, tanks, etc.) as deemed necessary by the AHJ.

3.03 TESTING

A. Testing: The systems shall be hydrostatically and operationally tested in accordance with the requirements of NFPA 13 and the AHJ. Any changes required to meet time or flow test requirements shall be made without additional cost to the Owner. Certificates of acceptance shall be submitted to the Architect/Engineer.

3.04 OPERATING AND OWNER INSTRUCTIONS

A. Typed Instructions: Typewritten, plastic covered, framed operational and maintenance instructions shall be mounted in the building(s) near each fire sprinkler riser. Information shall clearly indicate portion of the building covered by the system, type of system, location of sub-risers, locations of system drains, when system was placed into service, installed, installers name (company) and contact information for service, how to close and open system main valve, and other pertinent operational instructions. Provide reference to O&M manuals provided to the Owner for additional operation and maintenance instructions.

B. O&M Manual: See Division 01 and Division 20.

C. Owner Instructions: The Owner or his representative shall be instructed by the Sprinkler Contractor in the operation of the system. The instruction shall be given by Contractor's personnel who are considered qualified in the opinion of the Architect/Engineer and shall be for a minimum of two hours. Instruction shall include location of all valves, drains, and pipe routing, as well as proper maintenance and testing procedures.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Domestic Water Piping.

B. Valves.

C. Water Hammer Arrestors.

D. Trap Primers.

E. Testing and Inspection.

F. Flushing and Disinfection.

1.03 DEFINITIONS

A. "Lead-Free" means not containing more than 0.2% lead in solder and flux; and not more than a weighted average of 0.25% lead in wetted surfaces of pipes, pipe and plumbing fittings and fixtures.

1.04 SUBMITTALS

A. General: Submittals shall comply with Section 20 05 00.

B. Product Data: Submit manufacturer’s product information on all items to be used.

C. System Tests and Inspections: Submit documentation showing systems have satisfactorily passed all pressure tests and code inspections.

D. Cleaning and Disinfection: Submit documentation regarding completion of flushing, disinfection, bacteriological tests, and Health Department’s acceptance of tests and system.

1.05 GENERAL REQUIREMENTS

A. ANSI/NSF Compliance: All items in contact with potable water shall be lead free in accordance with ANSI/NSF 61. Plastic piping system components shall comply with ANSI/NSF 14. Only lead-free solder shall be used.

B. Valves: Shall be dezincification resistant, and shall not contain more than 15% zinc in their chemical composition.

1.06 REFERENCES

A. ASME B16.3: Malleable Iron Threaded Fittings.

B. ASME B16.15: Cast Bronze Threaded Fittings: Classes 125 and 250.

C. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings.

D. ASME B16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

E. ASME B16.24: Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500.

F. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.

G. ASTM B16.18: Seamless Copper Water Tube.

H. ASTM B32: Solder Metal.

I. AWS A5.8: Filler Metals for Brazing and Braze Welding.

J. AWWA B300: Hypochlorites.

K. AWWA B301: Liquid Chlorine.

L. AWWA M20: Water Chlorination and Chlorination Practices and Principles, 2nd edition.

M. ANSI/NSF Standard 61 Drinking Water System Components – Health Effects.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, 2.01, Acceptable Manufacturers.

B. Pipe and Fittings: Any manufacturer with products complying with the Contract Document requirements.

C. Valves: Conbraco/Apollo, Nibco, Stockham, Walworth, Milwaukee, Kitz, Red-White, Watts, Hammond.

D. Additional manufacturers are as listed for each individual item.

2.02 PIPE AND FITTINGS

A. Pipe: Seamless copper water tube, hard temper (unless noted otherwise), type K or L as indicated, per ASTM B88. Type K belowground; Type L aboveground.

B. Fittings:
   1. Solder-Joint: Wrought copper and bronze fittings per ASME B 16.22 and cast copper alloy fittings per ASME B16.18, cast bronze threaded fittings per ASME B16.15.
   2. Flanged: Cast bronze fittings per ASME B16.24.
   3. Solder Material: 95/5 tin-antimony solder per ASTM B32 or “Silvabrite 100" (95.5 tin/4 copper/0.5 silver) solder; lead free.
   4. Brazing Material: AWS A5.8, BCuP-5.

2.03 VALVES

A. Ball Valves: 600 psi non-shock cold working pressure, 100 psi at 300 deg F, bronze body, full port, 2 piece construction, anti-blowout stem, reinforced PTFE seats, stainless steel or chrome plated brass or silicon bronze ball, lever handle, solder or threaded connections. Provide with extended lever handle where valve is installed in systems with insulation thickness greater than 0.5 inch. Nibco S-585-66-LF, T-585-66-LF, Nibco S-585-80-LF, T-585-80-LF (or approved).

B. Drain Valves: Bronze ball valve, minimum 125 psi-swp, anti-blowout stem, stainless steel or chrome plated brass ball, reinforced TFE seat, solder or threaded inlet connection, male 3/4 inch hose thread outlet connection, with brass cap and chain. Nibco S-585-70-HC, T-585-70-HC (or approved).

2.04 ACCESSORIES

A. Water Hammer Arrestors: All metal, factory pre-charged with inert gas, sealed internal bellows; 125 psi working pressure. All wetted parts shall be type 300 stainless steel, brass or copper. PDI (Plumbing and Drainage Institute) sizes as indicated. Where not sized, provide sizes in accordance with PDI standards. Zurn "Shoktrol", Wade "Shokstop", or J.R. Smith "Hydrotrol".

B. Trap Primer Valve:
   1. Pressure Drop Type: Activated by drop-in water pressure. Constructed of corrosion resistant brass with integral backflow preventor, vacuum breaker ports, distribution manifold to suit number of drains served, adjustable to line pressure for water delivery. Precision Plumbing Products Model P-1 and P-2 (or approved).
   2. Water Flow Type: Activated by flow of water in line through the trap primer valve. Brass construction with integral air-gap backflow preventor, stainless steel screen, delivering 0.84 ounces of water at 20 psi with 5 seconds of water flow. Precision Plumbing Products “Prime-Pro” (or approved).

PART 3 EXECUTION

3.01 GENERAL

A. Workmanship:
   1. Installation of all items shall comply with code, best professional practices, manufacturers written installation instructions, and to allow for proper functioning of items being connected to.
   2. Install all piping parallel to the closest wall and in a neat, workmanlike manner. Horizontal exposed straight runs of piping shall not deviate from straight by more than 1/4-inch in ten feet. Vertical piping shall not deviate from plumb by more than 1/8-inch in ten feet.
   3. Do not run any piping above electrical panels (and similar electrical equipment). Provide offsets around such panels as necessary.

B. Complete System: Provide all piping as indicated and as required to allow supply connections to each fixture and equipment item requiring water supply. Provide offsets as required to accommodate building construction and access requirements per Section 20 05 00. For multistory buildings include costs to offset vertical piping at each floor level since structural member locations will not be the same on each floor.

C. Coordination: Coordinate installation of items with all trades that are affected by the work to avoid conflicts.

D. Expansion and Contraction: Install piping to accommodate system expansion and contraction; provide necessary offsets, expansion devices, anchors, guides and related accessories. See Section 20 05 29.

E. Openings for Piping: See Section 20 05 30 for sleeves and seals; provide openings in building construction sized to accommodate required sleeve size. Where sleeves are not required provide openings sized as follows:
   1. Belowground Penetrations: Inside diameter of opening shall be at least 2-inch larger than the outside diameter of the pipe or pipe covering (for covered piping systems), and so as to allow free movement of piping.
   2. Aboveground Penetrations: Inside diameter of opening shall be at least 1-inch larger than the outside diameter of the pipe or pipe covering (for covered piping systems), and so as to allow free movement of piping.

3.02 PIPE AND FITTINGS

A. Concealed: All piping in finished areas shall be installed concealed unless specifically noted otherwise. Provide escutcheons where piping is allowed to be exposed and pipe passes through building elements (i.e. walls, floors, ceilings, etc.).

B. Non-Obstructing: Install piping at such heights and in such a manner so as not to obstruct any portion of windows doorways, passageways, or access to any items requiring routine service, maintenance, or inspection. Offset or reroute piping as required to clear any interferences which may occur.

C. Drawing Review: Consult all drawings for location of pipe spaces, ducts, electrical equipment, ceiling heights, door openings, window openings, and other details and report discrepancies or possible conflicts to Architect/Engineer before installing pipe.

D. Insulation: Allow sufficient clearances for installation of pipe insulation in thickness specified. If interferences occur, reroute piping to accommodate insulation.

E. Drainage: Slope all piping to low points to allow the system to be drained. Provide added drain valves where system cannot be drained through fixtures.

F. Preparation for Joining: Prior to the joining of any section of pipe to a pipe run, the section shall be thoroughly cleaned inside and out, the ends shall be reamed to remove any cutting burrs and piping prepared as recommended by piping and fitting manufacturer.

G. Threaded Connections: Cut piping carefully, ream, thread and work into place without springing. Use TFE tape or lead and graphite lubricant (on male threads only).

H. Soldered Connections: Polish contact surfaces of fittings and pipes with emery cloth before fluxing male and female surfaces of joints. Steel wool and sandpaper not permitted for polishing.

I. Unions: Install unions in pipe connections to valves, coils, and any other equipment where it may be necessary to disconnect the equipment or piping for repairs or maintenance; and as indicated. Where flanged connections occur at equipment additional unions are not required unless indicated otherwise.

J. Insulating Unions: Install dielectric insulating connectors between all connections of copper piping and steel piping of steel equipment. Where flanged connections occur use insulating type flanges.

3.03 VALVES

A. General: Provide isolation valves as shown on the drawings. In addition to those shown, provide added valves to allow for the isolation of each group of fixtures, all water heaters, and all individual equipment items (e.g. dishwashers, heat exchangers, etc.).

B. Installation: Install valves so as to be easily accessible and oriented to permit ease of operation. Valve stem shall be directed toward operator in either the vertical or horizontal direction. Provide access doors for valves not otherwise accessible.

C. Drain Valves: Provide drain valves at the base of all risers (except not required where risers can be drained through plumbing fixtures or equipment drains). Provide drain valves at piping low points where the piping cannot be drained through fixtures, hose bibs, or equipment drains.

3.04 ACCESSORIES

A. Water Hammer Arrestors: Install per manufacturer's instructions, just upstream of last fixture on branch line. Provide water hammer arrestors on branch water lines serving fixtures with

flush valves, washer machines, solenoid valves, and similar quick-acting valves. Water hammer arrestors are typically not shown on the plans, but shall be provided per this paragraph. Provide ball isolation valve in piping to arrestor. Where access cannot be provided at water line location, the water hammer arrestor piping may be extended vertically and the water hammer arrestor located above ceiling outside of plumbing chase.

B. Trap Primers: Provide trap primers to all vented floor drains, floor receptors, and where required by the code. Install with an isolation valve in the branch line to the trap primer valve.

3.05 TESTING AND INSPECTION

A. All piping shall be tested, inspected, and approved by the local authority having jurisdiction prior to being concealed or covered.

B. Testing shall be witnessed by the plumbing inspector and the Architect/Engineer (at his option). Notify Architect/Engineer minimum 72 hours prior to date of testing, and mutually agreed upon times arranged.

C. Piping shall be hydrostatically tested for a period of 2 hours (or as required by local authority having jurisdiction), during which time no drop in pressure or leakage shall occur.

D. Test pressure shall be not less than 150 percent of the maximum to which the pipe will ordinarily be subjected; but in no case less than 75 psig.

E. Any leaks or defective piping disclosed by testing and inspection shall be repaired with new materials and the system re-tested.

F. Provide documentation to the Engineer indicating that the system has been completely pressure tested, and all portions inspected and accepted by the local authority having jurisdiction.

3.06 FLUSHING AND DISINFECTION

A. System Flushing: After tests are completed, all water piping shall be flushed. In general, sufficient water shall be used to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. System valves and fixture faucets shall be opened and re-closed to completely flush system. After flushing and cleaning, systems shall be prepared for disinfection service by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building during this process shall be repaired by the Contractor.

B. Disinfection:

1. Upon completion of the job and prior to final acceptance, the plumbing system shall be disinfected with Chlorine solution. Review procedures and disinfection with the authority having jurisdiction to insure that all work complies with code requirements. Verify any deviations from specified procedures with the Architect/Engineer prior to proceeding. The chlorinating material shall be either liquid chlorine conforming to AWWA B301 or hypochlorite conforming to AWWA B300 (or as otherwise required by the authority having jurisdiction). Water chlorination procedure shall be in accordance with AWWA M20 (or procedure acceptable to AHJ and to the Architect/Engineer). The chlorinating material shall provide a dosage of not less than 50 parts per million and shall be introduced into the system in an approved manner. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria.
2. The retention time shall be at least 24 hours and shall produce not less than 10 ppm of chlorine at the extreme end of the system at the end of the retention period. All valves in the system being sterilized shall be opened and closed several times during the contact

period. The system shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period all valves and faucets shall be opened and closed several times.

C. Bacteriological Tests: The Contractor shall employ an approved agency to take test samples at several points of the system (i.e. end of each wing, each floor of building, etc.) in properly sterilized containers and arrange with the Health Department (or a test agency acceptable to the Health Department) having jurisdiction to test the samples. Test for coliform and other items as required by the AHJ. Should the samples not test satisfactory, the system shall be re-flushed and disinfected again until satisfactory samples are obtained.

D. Submittal: Submit documentation stating that flushing and disinfection has been completed, copies of the bacteriological test results, and certification from the Health Department having jurisdiction stating that system has been found acceptable.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Soil, Waste and Vent Piping.

B. Miscellaneous Drains.

C. Cleanouts.

D. Testing and Inspection.

1.03 SUBMITTALS

A. General: Submittals shall comply with Section 20 05 00.

B. Product Data: Submit product information on all items to be used.

1.04 REFERENCES

A. ASME B 16.4: Gray Iron Threaded Fittings.

B. ASME B 16.12: Cast Iron Threaded Drainage Fittings.

C. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

D. ASTM A 74: Cast Iron Soil Pipe and Fittings.

E. ASTM A 888: Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

F. ASTM C 564: Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

G. ASTM C 1277: Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.

H. ASTM F 477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

I. CISPI 301: Hubless Iron Soil Pipe and Fittings for Sanitary and Drain, Waste, and Vent Piping Applications.

J. CISPI 310: Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, 2.01, Acceptable Manufacturers.

B. Pipe and Fittings: Mueller, Cerro, Tyler, Charlotte Pipe and Foundry, AB & I Foundry, Spears Manufacturing, Cresline Northwest.

C. No Hub Couplings: ANACO, Mission Rubber, Tyler, MG Coupling, Fernco, Clamp-All, Mifab. Ideal-Tridon.

D. Cleanouts: Josam, Zurn, J.R. Smith, Wade.

2.02 PIPE AND FITTINGS - MATERIALS

A. No-Hub Cast Iron Pipe and Fittings:
   1. Pipe and Fittings: Service weight no-hub cast iron pipe and cast iron fittings, per CISPI 301 and ASTM A 888, for use with mechanical no-hub couplings.
   2. Couplings: Per CISPI 310 or ASTM C 1277, with a cast iron or stainless shield, and neoprene gasket per ASTM C 564.

2.03 PIPE AND FITTINGS – APPLICATION

A. Waste and Vent:
   1. Piping 2-1/2 Inches and Smaller Located Above Ground: No-hub cast iron.
   2. Piping 3 Inches and Larger Located Above Ground: No-hub cast iron.
   3. All Piping Located Below Ground: No-hub cast iron.

2.04 CLEANOUTS

A. General:
   1. All cleanouts shall have cast iron bodies with bronze countersunk rectangular slotted plugs, lubricated with a non-hardening teflon base thread lubricant and having a gasket seal.
   2. Cleanouts located in waterproof membrane floors shall be provided with an integral cast flange and flashing device.
   3. All cleanouts shall be the same size as the pipe which they are intended to serve (but not larger than 4-inch).
   4. Pipe fittings for cleanouts which turn through walls or up through floors shall use long sweep ells or a "Y" and 1/8 bend.
   5. All cleanouts and access covers shall be provided with vandal proof screws.

B. Floor Cleanouts: J.R. Smith No. 4100 Series adjustable floor cleanout with round heavy duty nickel bronze top.

PART 3 EXECUTION

3.01 GENERAL

A. Installation of all items shall comply with code, best professional practices, manufacturers written installation instructions, and to allow for proper functioning of items being connected to.

B. Provide all piping as indicated and as required to allow complete and proper waste, drain, and vent connections to each fixture and equipment item requiring connection. Provide offsets as required to accommodate building construction and access requirements per Section 20 05 00. For multistory buildings include costs to offset vertical piping through each floor level since structural member locations will not be the same on each floor.

C. Coordinate installation of items with all trades that are affected by the work to avoid conflicts.

D. The work of this section shall include all waste (sanitary sewer), drain, and vent lines inside of the building and 5-feet outside of the building (unless indicated otherwise), to the point of and including connections to outside sanitary sewer lines or sanitary sewer manholes.

E. Consult manufacturers data and architectural drawings for information on plumbing fixtures before beginning rough-in.

F. Verify points of connection, invert elevations, and grade requirements before beginning installation or ordering materials.

G. Stub all piping for all items requiring connections through wall or floor; cap and protect until connection to items is complete.

H. Trap all fixtures and equipment items as required by governing code; provide proper venting for each trap.

I. Provide piping connections to equipment furnished by others in accordance with Section 20 05 00.

J. All excavation, trenching and backfilling shall comply with code and pipe manufacturers recommendations. Below ground plastic pipe installation shall comply with ASTM D 2321 and shall exceed those standards as specified.

3.02 PIPE AND FITTINGS

A. All piping in finished areas shall be installed concealed unless specifically noted otherwise.

B. Install piping so as not to obstruct access to any items requiring routine service, maintenance, or inspection. Offset or reroute piping as required to clear any interferences which may occur. Prior to running any piping, confirm with Architect/Engineer (unless is clearly noted to be ran exposed). Install exposed piping so as not to obstruct any portion of windows, doors, doorways, passageways, or items requiring service or access.

C. Consult all drawings for location of pipe spaces, ducts, electrical equipment, structural elements, ceiling heights, door items requiring access, openings, window openings, and other details and report discrepancies or possible conflicts to Architect/Engineer before installing pipe.

D. Install all horizontal soil or waste lines with a slope of 1/4-inch per foot unless noted otherwise. Coordinate with AHJ if written approval is required for exceptions to 1/4-inch per foot slope.

E. Make all changes of direction and junctions with Y fittings and 1/8 bends; use sanitary tee fittings in vertical pipe only.

F. Provide escutcheons where exposed pipe passes through walls, floors, or ceilings.

G. Install all piping parallel to the closest wall and in a neat, workmanlike manner. Horizontal straight runs of piping shall not deviate from straight by more than 1/4-inch in ten feet. Vertical piping shall not deviate from plumb by more than 1/8-inch in ten feet.

H. Do not run any piping above electrical panels (and similar electrical equipment). Provide offsets around such panels as necessary. Such offsets are typically not shown on the plans, but are required per this paragraph.

I. Prior to the joining of any section of pipe to a pipe run, the section shall be thoroughly cleaned inside and out, the ends shall be reamed to remove any cutting burrs and piping prepared as recommended by piping and fitting manufacturer.

J. Threaded Connections: Cut piping carefully, ream, thread and work into place without springing. Use TFE tape or lead and graphite lubricant (on male threads only).

K. Soldered Connections: Polish contact surfaces of fittings and pipes with emery cloth before fluxing male and female surfaces of joints. Steel wool and sandpaper not permitted for polishing.

3.03 INSTALLATION OF CLEANOUTS

A. General: Install cleanouts in all soil and waste piping:
   1. As shown on drawings.
   2. At no more than 100 foot intervals on horizontal runs (whether shown on drawings or not).
   3. At the end of all piping runs.
   4. At the base of all vertical risers.
   5. At all changes of direction for a run of 10 feet or over.
   6. Where needed to correct possible stoppage.
   7. As required by Code.

B. Elevations:
   1. Floor cleanouts shall be installed so as to be flush with the finished floor; where recessed cleanout covers are used the recess shall be filled flush with material to match the surrounding finished floor.

C. Clearances and Access: Install cleanouts so as to assure proper clearances as required by governing code. Where cleanouts occur in concealed spaces provided extensions to floors above or to walls to allow access. Provide wall access covers or access doors for all wall cleanouts. See Section 20 05 19 for access doors.

3.04 TESTING AND INSPECTION

A. All piping shall be tested, inspected and approved prior to being concealed or covered.

B. Testing shall be by water or air, and comply with code.

C. Testing shall be witnessed by the code official, the Owner's representative (at their option), and the Engineer (at their option). Prior to beginning testing confirm with the Owner and Engineer their level of involvement in the testing process and extent of witnessing; where they will be witnessing the testing notify them at least 72 hours in advance of the test and confirm their availability; coordinate and reschedule as necessary and arrange mutually agreed upon times for the tests and witnessing to occur.

D. Water Testing:
   1. Fill system with water so that there is no less than 10 feet of head above the highest system section being tested.
   2. System shall hold pressure for a period of at least 15 minutes with no leakage before the inspection starts.
   3. The system shall be inspected and shall hold tight with no leakage at all points.

E. Air Testing:
   1. Pressurize system with air so that there is no less than 5 psig of air pressure in the system.
   2. System shall hold pressure for a period of at least 15 minutes without the introduction of additional air before the inspection starts.
   3. The system shall be inspected and shall hold tight with no leakage at all points.

F. All leaks shall be eliminated and the system re-tested before proceeding with work or concealing pipe.

G. All repairs to piping shall be with new material and no caulking of screwed joints or holes is allowed.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Plumbing Fixtures and Trim.

B. Installation/Connection of Equipment Specified Elsewhere.

C. Adjustment and Cleaning.

1.03 DEFINITIONS

A. "Plumbing Brass" means "P-traps, stops, strainers, tailpieces, flanges, and other brass fittings and accessories NOT including faucets or stops."

B. "Trim" includes all plumbing brass items, faucets, and any fixture accessories.

C. "Accessible" refers to the American's with Disabilities Act, and infers that these fixtures will meet Federal and local code requirements.

D. "Lead-Free" means not containing more than 0.2% lead in solder and flux; and not more than a weighted average of 0.25% lead in wetted surfaces of pipes, pipe and plumbing fittings and fixtures.

1.04 REFERENCES

A. UPC: Uniform Plumbing Code.

B. NSF/ANSI Standard 61: Drinking Water System Components – Health Effects.

1.05 SUBMITTALS

A. General: All submittals shall comply with Section 20 05 00.

B. Product Data: Submit product data for all plumbing fixtures, plumbing trim, and water heaters.

1.06 GENERAL REQUIREMENTS

A. Fixture Quality: Provide new fixtures and fittings, approved, free from flaws and blemishes with finished surfaces clear, smooth and bright. Visible parts of fixture brass and accessories, and all items located in accessible cabinet spaces, shall be heavily chrome plated. All stops, P-traps and items exposed to view shall be chrome plated (except where specifically noted otherwise).

B. Code Compliance: All products and connections shall be in compliance with code, local Utilities Department standards, and Health Department requirements.

C. Spare Parts: Provide two spare stop valves.

1.07 QUALITY ASSURANCE

A. General: Provide quality assurance checks specified in Section 20 05 00 prior to submitting product data. By submitting products for Engineer’s review, the Contractor is confirming that

such checks have been performed and that the products are suitable for the intended installation and use.

B. Fixtures:
   1. Types: Verify specified fixture types with the Architectural and Plumbing drawings to confirm the requirements are consistent (e.g. fixtures are wall mounted versus floor mounted type, locations of ADA fixtures match, etc.). Where conflicts occur clearly identify the issue on the fixture submittal along with a proposed resolution; or resolve prior to making the submittal by the project RFI process.
   2. Space Verification: Prior to ordering any fixtures or making submittals, Contractor shall check the drawings and verify that all fixtures will fit the space available (i.e. fixtures fit any cabinets fixtures are to be installed in; fixtures have adequate access clearances for proper use; etc.).

C. Lead-Free Requirement: All items in contact with potable water shall be lead free. Fixtures used to dispense potable water for drinking shall meet the requirements of NSF/ANSI 61.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Paragraph 2.01, Acceptable Manufacturers.

B. Water Closets: Kohler, American Standard, Eljer, Mansfield, Acorn.

C. Water Closet Seats: Church; Beneke; Olsonite; Kohler; Bemis, Acorn.

D. Floor Drains and Floor Receptors: J.R. Smith; Zurn; Josam; Mifab.

E. Plumbing Brass: McGuire; American Standard; Brasscraft; Dearborn Brass; Chicago Faucet; Crane; Eljer; Frost; Kohler; Speakman; Symmons; T & S Brass; Elkay.

F. Stops: McGuire; Brasscraft; ProFlo.

G. Flush Valves: Sloan, Zurn.

H. Hot Water Temperature Limiting Valve: Symmons, Watts, Chicago Faucet, Acorn Controls, Leonard, Cash Acme.

2.02 PLUMBING FIXTURES

A. General:
   1. Plumbing Fixtures are listed below by reference numbers, corresponding to the reference number adjoining these items on the drawings.
   2. All vitreous china and enameled cast iron fixtures shall be finished white unless specifically noted otherwise.
   3. All stainless steel sinks shall be sound deadened, and shall have faucet ledge (except where noted specifically without ledge).
   4. In interests of Owner's Standardization, fixtures of similar type shall be product of one manufacturer; trim of similar type shall be product of one manufacturer.

B. Water Closets:

   P-1A Combination Water Closet/Lavatory - Security:

   Fixture - General: Acorn “Ligature Resistant” Series LR1418 blowout jet type, on floor, back outlet, elongated bowl, integral water closet seat, multi-sided lavatory bowl, stainless steel security fixture. Fixture shall be designed with hemispherical cabinet and related features to reduce risk of being used as a ligature device. Fixture shall be fabricated from minimum 14

gauge type 304 stainless steel, seamless welded, exposed surfaces having a satin finish, and contoured toilet seat having a sanitary high polish finish. Water closet trap shall comply with ASME A112.19.3, flush with 25 psi, and have a minimum 3.5-inch trap seal that shall pass a 2.125-inch diameter ball and be fully enclosed. Water closet shall have self-drain flushing rim, and integral seat. Lavatory shall be approximately 12-3/4" x 8-1/4" x 5" deep, with faucet, non-hold open feature, and 0.5 gpm flow. Fixture shall have an air-circulating self-draining soap dish, and penal bubbler (type BP without mouth guard). Fixture shall be able to withstand loadings of 5000 pounds without damage. Fixture cabinet interior shall be sound deadened with fire resistant material. Fixture shall be provided with accessories for proper mounting and installation. All push buttons shall be hemispherical.

Fixture - Specifics: Water closet shall flush with 1.6 gallon mechanical flush valve. Fixture shall be for use with concealed flush valve. Fixture shall have centered toilet. Lavatory faucet shall be hot/cold temperature mixing type operated with push/rod fulcrum assembly. Fixture shall include: 3" cleanout with pinned cleanout plug, Flood-Trol, flush valve through wall connector, wall sleeve, fixture template, lavatory overflow, combined waste, paper holder, toothbrush holder, towel hook, and gasketed toilet waist wall outlet.

Flush Valve: Sloan "Royal Prison" series, model to suit fixture used with. Shall be concealed hydraulic prison-type flush valve, rough brass flush valve with vacuum breaker, non hold open actuator, hydraulic tubing, wheel handle angle stop, flush tubes and elbow for connection to fixture.

C. Floor Drains:

P-11A Floor Drain:

J.R. Smith No. 20059-B cast iron body floor drain, with square stainless steel adjustable strainer head, square stainless steel grate, vandal proof screws, reversible flashing collar, and trap primer connection. Size drain outlet to match pipe size shown on drawings.

2.03 SPECIALTIES

A. General: Unless indicated otherwise, the following fittings and materials (i.e. specialties) shall be used.

B. Fixture Traps: 17 gage seamless chrome plated cast brass tubing, with 2 inch minimum seal, cast brass slip nuts, size as required by Uniform Plumbing Code (unless a larger size is indicated), and configured to suit the application. Provide with cleanout where indicated or required by code.

C. Exposed Piping and Fittings: In finished areas and in accessible cabinets, provide piping with chrome plating or sleeved with chromed sleeves or of stainless steel construction/finish; all chrome to have a bright polished finish. No exposed copper allowed (includes accessible cabinet areas).

D. Stops: Quarter turn ball valve type, chrome plated, UPC compliant, with low lead brass body, rated for minimum 125 psi operating pressure and temperature of water used with plus 20 deg F. Size and configuration to suit application. Provide with loose key where installed in areas with public access.

E. Risers: Flexible braided steel type; rated for 125 psig.

F. Escutcheons: See Section 20 05 19.

G. Hot Water Temperature Limiting Valve: Thermostatic water temperature mixing valve with integral checks, complying with ASSE 1070 and UPC Chapter 4. Brass body with brass and stainless steel internal components. Leonard "ECO-Mix" 270 or Symmons "Maxline" Model 5-210.

H. Sealant: See Section 20 05 30. Sealant at fixtures shall be the silicone type, color to match fixture.

PART 3 EXECUTION

3.01 INSTALLATION OF FIXTURES

A. General: All fixtures shall be completely connected to piping as needed to make a complete and operable installation.

B. Fixture Locations: Mounting heights and locations of fixtures shall be as shown on the Architectural drawings and in accordance with Contract Document requirements. Locations shall be verified and coordinated with the various trades affected by the installation of these fixtures. When none indicated or shown, obtain mounting location and heights from the Architect/Engineer prior to installation. Floor drains shall be installed in proper locations and coordinated with floor slopes so that drains are set at low points to allow for floor drainage. Floor receptors (or floor sinks) shall be set flush with floors to allow drains to serve as both indirect drain receptors and as floor drains (unless noted otherwise or required to be elevated by code).

C. Rough-In: Determine rough-in location of fixture utilities to suit fixture location, fixture dimensions, elements of construction (i.e. beams, studs, electrical, ducts, etc.), access requirements, casework dimensions, items which may drain/connect to fixture, use of fixture, and related considerations. The fixture rough-in locations indicated on the plans is schematic, and is not to be used for final rough-in purposes. Coordinate fixture locations with other systems so that either conflicting items are relocated or fixture locations are adjusted to suit.

D. Offsets: Provide offsets in piping to fixtures to accommodate building systems. Such offsets shall include off-setting waste piping into cabinet bases (in kick space where possible) to accommodate beams located directly below walls behind fixtures.

E. Carriers: All off-the-floor (i.e. wall) mounted fixtures shall be installed with supporting carriers and additional anchors, bracing and supports to transmit fixture loads to the floor and building structure without exceeding the maximum specified fixture movement. Prior to concealing carrier and associated supports review adequacy of support system with Architect/Engineer.

F. Fixture Sealant: Where fixtures abut to walls, floors, and cabinets seal all joints with a uniform fillet bead of sealant. Provide at other locations as recommended by fixture manufacturer.

G. Protection: Protect fixtures against use and damage until project substantial completion; provide guards and/or boxing to protect.

3.02 INSTALLATION OF SPECIALTIES

A. Escutcheons: Provide escutcheons at each point where an exposed pipe or other fitting passes through walls, floors, backs of cabinets, or ceilings.

B. Stops: Provide stops in water connections to all fixtures/equipment, except where a stop valve is integral to the fixture (e.g. flush valves) and in water connections to all items not served by another valve.

C. Hot Water Temperature Limiting Valve: Install on all lavatories, hand wash sinks, bathtubs, showers, whirlpools, bidets and at fixtures required by Code (reference UPC Chapter 4); set for 115 deg F maximum delivery temperature. Test and adjust for proper operation and submit written report documenting work performed.

3.03 ADJUSTMENT AND CLEANING

A. Cleaning: After completion of installation remove all labels and thoroughly clean all fixtures, trim and fittings.

B. Adjustment: Adjust all flush valves, fixture stops, faucets, valves, and associated plumbing items as necessary for the proper operation of all fixtures and equipment.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Control System Design.

B. Control System for Building Heating, Ventilation, Air Conditioning, Exhaust.

C. Control Devices, Components, and Wiring.

D. Testing, Adjustment, and Commissioning.

E. Owner Training.

1.03 SUBMITTALS

A. General: Shall comply with Section 20 05 00.

B. Product Data: Submit product information on all items to be used.

C. Shop Drawings: Submit a complete set of shop drawings prior to installation containing the following information: interconnect drawings showing all wiring and control connections; control panel details; arrangement of devices in panels; schedule of dampers with sizes and where used; sequence of operation for all equipment; location of all control devices on scaled building plans; and list of actuators with sizes and where used.

D. Labeling: Submit list of proposed component labeling.

E. Operation and Maintenance Manuals: See Section 20 02 00. In addition to the information required by that Section and Division 01, provide (for inclusion in the Manual) the following:
   1. System description.
   2. Complete sequence of operation.
   3. Reduced size (11" x 17") copies of record drawings.
   4. Submittal data on all products.

F. Commissioning Plan and Report: See Section 20 08 00. Provide commissioning plan; including a checklist of control items to be reviewed and method of testing sequence of operation. Submit final report documenting tests performed and results.

1.04 GENERAL REQUIREMENTS

A. Design and Installation: The entire control system shall be designed and installed by skilled control system designers, electricians and mechanics, all of whom are properly trained and qualified for the work they perform.

B. Sole Responsibility: One single Contractor shall be responsible to design, furnish and install the complete Section 23 09 33 control system.

C. Sequence: System shall have sequence of operation as specified in Section 23 09 93.

1.05 WARRANTY

A. Warranty: After completion of the installation of the control system and acceptance by the Owner, the system shall be warranted as free against defects in manufacturing, workmanship and materials for a period of two years from date of substantial completion. In addition, the system shall be warranted to provide the sequence of operation and basic features specified, with the accuracy and flexibility also specified. The system shall be repaired or replaced, including materials and labor, if in Owner's and Engineer's reasonable opinion, system is other than as warranted.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Acceptable Manufacturers.

B. Thermostats and Time Clocks (Non DDC): Honeywell, Paragon.

C. Actuators: Belimo, Honeywell, HVAC equipment manufacturers.

D. Dampers: Ruskin, Greenheck.

E. Sensors: Honeywell, Vaisla.

F. Control Accessories: Idec, Hoffman, McDonnell, Tridelta, Edwards, Mamac, Penn, Belimo, Honeywell, Johnson Controls, Leviton, Arrow-Hart, Alerton.

2.02 BASIC SYSTEM

A. System Type: The system shall be an electronic or electric type.

2.03 THERMOSTAT AND TIMECLOCK

A. Programmable Thermostat: Shall be 7-day programmable solid state type, specifically designed for commercial use. Unit (and related relay module, and controls) shall allow for 1st-stage economizer cooling, 2nd stage unit cooling, 1st stage heating, 2nd stage heating and provide other features as required by the sequence of operation. Thermostat shall have means to bypass time clock, have Auto-Cool-Off-Heat switching, setpoint adjustments, and time/day adjustments. Unit shall also have capability for averaging multiple remote thermostat sensors. Honeywell T7351 Series, other Honeywell series (as required to provide sequence and match unit furnished), or approved.

B. Logic module: Solid state control package to provide economizer functions. Shall include logic module, sensors, and accessories necessary to provide a complete and operational system, and shall be compatible for use with specified HVAC equipment and programmable thermostat. May be integral to thermostat.

C. Accessories: Provide duct temperature sensors required for mixed air applications; shall be the averaging type with a sensor element type so as to sense a representative sample of the medium being controlled. Provide sensors as required to work with economizer controls.

D. General Time Clock: 365 day programmable timeclock, for control of up to four independent loads each with a different schedule, with 50 setpoints of programming. Each output able to be programmed as a maintained or momentary contact closure with duration of 1 to 59 seconds. Features shall include: Time of day scheduling, holiday programming, daylight savings time adjustment, leap year correction, manual override, and battery back-up (for one month operation without power). Unit shall have a NEMA 1 enclosure. Paragon EL74 (or approved).

2.04 CONTROL DAMPERS

A. Type: Dampers shall be parallel blade or opposed blade type, as selected by contractor to best suit application (unless a specific type is indicated).

B. Leakage: Class 1A leakage rated in accordance with AMCA 511 (or better, as required by Code).

C. Construction: Construct of galvanized steel, except where installed in ducts of stainless steel or aluminum construction or handling corrosive air, shall be of stainless steel or aluminum construction (to match duct material). All materials in contact with the airstream shall be suitable for the conditions without deterioration. Provide special coatings as necessary to provide corrosion resistance. Frame shall be minimum 16 gauge.

D. Blades: Single blade type, not exceeding 6 inches in width,16 gauge, with neoprene, extruded vinyl or butyl rubber edge seals and flexible metal jamb seals; linkage interconnecting all blades and actuator axle.

E. Bearings: Nylon, molded synthetic or oil impregnated sintered metal bearings (or other materials as conditions require).

2.05 ACTUATORS

A. Type: Actuators shall be a brushless DC motor type controlled by a microprocessor.

B. Operation: Shall be compatible with control devices used with to provide specified sequence and system features. Run time shall be constant, independent of torque. Actuator shall have manual positioning mechanism and control direction of rotation switch accessible on its cover. Provide with auxiliary switches as required for sequence of operation. Actuator shall be proportional or two position type, as required for application.

C. Sizing: Provide actuator with sufficient power and torque to suit items being controlled and allow proper operation against system pressures liable to be encountered. Actuator shall be capable of driving controlled items from full closed to full open in less than 15 seconds.

D. Spring Return: All actuators shall spring return upon power interruption: The spring return position shall be a “fail safe" position as dictated by freeze, fire, temperature protection, energy saving, or safe operating requirements. Outside air dampers shall spring return closed; return air dampers shall spring return open. VAV terminal units and zone dampers do not require spring return actuators.

E. Accessories: Units shall be complete with all linkages, brackets, and hardware required for mounting and to allow for proper control and operation.

2.06 PRESSURE SENSOR/TRANSMITTERS

A. Air Differential Pressure Sensor: Electronic transducer, incorporating linear variable differential transformer type sensing element with two-wire 0-10 VDC transmitter. Accuracy shall be +/- 2% of full scale. Submit chosen spans for review.

2.07 ROOM PRESSURE MONITOR

A. Room Differential Pressure Monitor and Controller: Bi-directional through the wall sensor, capable of audible and visual alarms with multiple alarm set points, multiple levels of password protection, disable function, programmable time delay and accuracy shall be +/- 2% of full scale. TSI - RPM10 (or approved).

B. Provide tamperproof stainless enclosure with perforated openings on detention side of wall.

2.08 ACCESSORIES

A. Wiring and Conduit: Shall comply with Division 26 specifications and with code. Wiring that performs code required life safety shutdown of equipment or fire alarm interface shall comply with NFPA standards and local codes for fire alarm system wiring.

B. Control Cabinet: Wall mounted, NEMA construction type to suit application, minimum 14 gauge sheet metal, hinged front door with latch. Size as required to house controls.

C. Relays: Shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dust-proof enclosure. Relays shall have Hand-Off-Auto switch, and LED's (or pilot lights) to indicate the energized mode. Relays shall be rated for a minimum life of one million cycles. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays should be equipped with coil transient suppression devices to limit transients to 150% of rated coil voltage. Contact rating, and configuration selected to suit application.

D. Miscellaneous Components/Sensors/Transmitters/Transformers: Shall be manufacturer's standard, designed for application in commercial building HVAC control systems, compatible with other components so as to provide sequence of operation specified.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Provide all devices, sensors, relays, switches, dampers, actuators, conduit, tubing, wiring, motor starters and all other devices required to provide a complete integrated control system with the sequence of operation and features as specified. It is the Contractor's responsibility to coordinate with other trades for the installation of control devices in systems installed by others.

B. Installation: Install all control components in accordance with manufacturer's instructions and recommendations and best professional practices.

C. Coordination: Coordinate work with other trades to ensure that all trades have the information necessary so that they may properly install any necessary control components, interconnect with control components, and install their work to accommodate controls. Identify all items requiring ceiling or wall access doors (or other special requirements) to trade installing access doors or performing related work.

D. Space Requirements and Locations: Carefully check space requirements and coordinate with other trades to ensure that items can be installed in the allotted spaces, including above finished suspended ceilings. Adjust locations of panels, equipment, devices, and the like, to accommodate work and prevent interferences. Determine the exact route and location of wiring, conduit and other control devices prior to beginning work.

E. Mounting: Mount controls adjacent to associated equipment on vibration free elements on free standing fabricated supports; mount and locate for best access.

F. Control Cabinets: All electrical devices, relays, and components shall be installed in protective covers (i.e. control cabinets), except where installed concealed above ceilings a cover is not required. Controls/devices shall be logically assembled in cabinet, with all devices and cabinet labeled.

G. Thermostats: Room thermostats shall be mounted 4'-6" above finished floor unless indicated otherwise. Thermostats shall connect to the HVAC unit serving the space the thermostat is located in, unless indicated otherwise. Not all thermostats are shown on the drawings and those shown are preliminary only. Contractor shall indicate all final thermostat locations on

submittal drawings. Contractor is responsible to coordinate locations to avoid tackboards, casework, and other interferences.

H. Power: It shall be the responsibility of this Contractor to provide power for all control devices requiring power. Coordinate with the Division 26 Contractor to arrange for necessary power circuits. All control devices shall obtain power from circuits dedicated to control power.

I. Wiring, Conduit and Electrical:
   1. General: Provide all electrical wiring and devices in accordance with applicable codes and Division 26 requirements.
   2. Conduit: All wiring shall be installed in conduit and in accordance with Division 26 specifications, except that low voltage wiring within ceiling plenum spaces, mechanical mezzanines, and attics may be installed without conduit. Wiring in walls shall be in conduit.
   3. Wire Labeling: Label or code wiring at each end to show location of the opposite end. Each point of all field terminal strips shall be permanently labeled or coded to show the instrument of item served. Color coded cable with cable diagrams may be used to accomplish cable identification and terminal strip.
   4. Service Loop: Provide minimum of 6” extra wiring at all wiring terminations for ease of future maintenance/servicing. Such extra wiring shall be neatly coiled/bundled to allow for uncoiling when the connected equipment is serviced.
   5. Workmanship: Install all conduit and wiring parallel to building lines, in neat bundles, supported at not less than 5 foot intervals.

J. Component Labeling: All control components, except regular room thermostats, shall be equipped with name plates to identify each control component. Components in finished rooms shall be labeled as to generic item controlled for better user understanding; other devices shall be labeled with the same designation which appears on the Control Diagrams. Contractor shall submit list of proposed labeling prior to installing. Reference Section 20 05 00.

K. Thermostat Setpoints: Thermostat Setpoints (all adjustable) shall be as follows unless indicated otherwise:

Occupied Heating	70 degrees F
Unoccupied Heating	65 degrees F
Occupied Cooling	75 degrees F
Unoccupied Cooling	85 degrees F

L. Motor Starters: Shall be by Division 26.

M. Device Duct Installation: All control devices installed in ductwork shall be positively anchored and attached to the ductwork by mechanical means (fasteners, straps, unistrut, etc).

N. Miscellaneous Controls: Provide all miscellaneous control items as noted in the Contract Documents. Provide all necessary control wiring between items for proper control.

3.02 INSTALLER COMMISSIONING

A. General: The commissioning specified in this paragraph is independent and separate of the commissioning work of Section 20 08 00 and is to be provided by the Section 23 09 33 system installer.

B. Commissioning:
   1. General: Check all system connections and control components for proper installation. Provide testing of the control system to verify proper system operation and that the specified sequences of operation are provided. Commissioning shall include checking system under all modes of operation, documenting system performance, making

corrections as required for proper operation, and re-testing as needed to obtain final proper operation.

2. Dampers: Verify all dampers operate through their full range of motion and in the proper direction in response to controls signals.
3. Sensors/Thermostats: Check measurements of temperature sensors, thermostats, pressure sensors and other devices against independent readings to confirm proper operation and sensor locations. Readjust sensor locations as necessary to account for field conditions that may cause inaccurate measurements.
4. Calibration: Calibrate items as necessary to allow for their proper operation.
5. Adjustments: Adjust system settings as needed to allow for best system operation, consistent with the specified sequences and for facilities of the type the system serves.

C. Start-Up: Coordinate all system and equipment start-up with other trades. Start-up systems in accordance with equipment manufacturer's instructions and in conjunction with trades that installed the items being controlled, so that they (or manufacturer's representatives) are present at start-up. Operate and configure the controls for safe equipment start-up and so that equipment operates in a controlled manner. See equipment specification sections for equipment start-up requirements. Test and observe all equipment being controlled during start-up to confirm proper controls operation.

3.03 THIRD PARTY COMMISSIONING

A. Coordination: Coordinate with other firms providing commissioning services; operate the control systems as needed by these other firms to allow for their commissioning work. See Section 20 08 00.

3.04 OWNER INSTRUCTION

A. Owner Instruction: Provide instruction to Owner on the operation and maintenance of the control system. Provide field demonstrations and show Owner the locations of all control devices; explain and demonstrate how system adjustments are made; explain and demonstrate system sequences of operation.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Sequence of Operation.

1.03 SUBMITTALS

A. General: Shall comply with Section 20 05 00.

B. Sequence: Submit complete description of sequence of operation. Sequence submitted shall not be a direct copy of the sequence specified herein, but shall be written to reflect the actual control sequence provided.

C. Shop Drawings: Provide complete control system shop drawings; see Section 23 09 33.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. General: Provide complete control system with sequences of operation as specified. All mechanical equipment shall be automatically controlled by the Division 23 control system, unless specifically indicated otherwise. Where no sequence of operation is indicated submit a proposed sequence for Engineer review; such sequences shall match the intended equipment use, code, and ASHRAE standards for the type of equipment and application.

B. Time Control: Control system shall provide time schedule control (i.e. occupied/unoccupied/ warm-up modes switching) for all mechanical equipment. Provide independent occupied/unoccupied schedules and optimum start (i.e. warm-up) cycle for each HVAC units (unless noted otherwise), all fans having time schedule, and all heaters. Except that exhaust fans serving adjacent restroom areas may share time schedules.

C. Warm-up Control: Control system shall provide warm-up switching for all HVAC units and items indicated as having a warm-up cycle.

D. Adjustability: All temperature setpoints and time control settings shall be adjustable.

E. Thermostats: Various thermostats are not shown on the drawings but are required per the sequence of operation specified. Coordinate with Engineer for location of all such thermostats prior to installing. Indicate proposed locations on submittals.

F. Miscellaneous Items: See plans for units with motorized dampers in the ducts and miscellaneous other items requiring control.

3.02 ROOFTOP HEAT PUMP UNIT

A. General:

1. Controls shall control the units cooling, heating, system dampers (economizer), in proper sequence to provide a supply air temperature that will satisfy space conditions.

2. Heating and cooling shall be properly sequenced so that there is no overlap between the use of heating and cooling.

B. Occupied Mode:
   1. Fan shall run continuously.
   2. Unit shall cycle in heating or cooling modes as required to satisfy space thermostat.
      a. Heating: Heat pump shall operate at 1st stage of heating, with electric heater as final stage.
      b. Cooling: Heat pumps with economizers shall use outside air as the first stage of cooling. Economizer shall be dry bulb or enthalpy type, using Outside Air (OA) temperature sensor, mixed air temperature sensor and supply air temperature control scheme. Economizer shall be enabled only when OA temperature (or enthalpy) is less than the units Return Air (RA) temperature (or enthalpy). The OA/RA dampers shall be modulated as required to satisfy the supply air temperature control scheme. Heat pump shall operate in the cooling mode as the final stage of cooling.
   3. OA dampers shall be in the minimum position when unit is in heating and under economizer control when unit is in cooling. OA damper shall not close below the minimum airflow setting indicated on the plans; coordinate with balancer for minimum setting.
   4. Powered Exhaust Fan: Shall be controlled by space pressurization and shall modulate to maintain a positive space pressure of .08” w.c.

C. Unoccupied Mode: Fan shall not run continuously. Unit’s fan and heating/cooling shall cycle on and off as required to maintain setback temperatures. Outdoor air dampers shall be fully closed.

D. Warm-up Mode: Unit shall run as in the unoccupied mode (outdoor air dampers fully closed) until the space temperature has warmed up to the occupied mode heating setpoint, then unit shall operate as specified for the occupied mode.

E. Mode Control: Units' mode of operation shall be determined by unit thermostat time schedule and time schedule override; warm-up mode shall be initiated by thermostat’s optimum start controls.

3.03 EXHAUST FANS

A. General: See "Control" column on Fan Schedule for which of the following control methods apply to each fan.

B. 24/7 Control: Fan shall run continuously and shall be balanced with a VFD.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Ductwork Systems.

B. Flexible Duct.

C. Acoustical Duct Lining.

D. Preparation of Duct for Service.

1.03 DEFINITIONS

A. Duct Sizes: All duct dimensions shown are inside clear dimensions. Where inside duct lining is specified or indicated, duct dimensions are to the inside face of lining.

1.04 QUALITY ASSURANCE

A. All work and materials shall comply with SMACNA-DCS, NAIMA-DLS, ASHRAE-F, IBC, IMC, and code. The most restrictive criteria governs.

B. Leakage Criteria: Duct system shall be constructed and sealed so that leakage does not exceed the following:
   1. All Systems - Supply Duct: From fan to connection to air outlet 5%.
   2. All Systems - Return Duct: 5%.
   3. All Systems - Exhaust Duct: 5%.

C. Fabrication Proximity: The Contractor performing the work of this section shall have fabricating facilities located within 100 miles of the project site.

D. Drawing Review: Prior to beginning any work review all drawings, duct routing, duct connections, equipment configuration, equipment connection locations, and other work details to discover conflicts in anticipated duct arrangement and improper or incomplete connections. Review shall include the following: supply ducts not connected into return (or exhaust) ducts, ducts not crossed and improperly connected in shafts, air outlets/inlets connected to ducts, unit configuration compatible with planned duct connections, louver locations match architectural plans. Submit resolutions of such possible conflicts as submittals with shop drawings of proposed solutions; written description in lieu of shop drawings is acceptable for minor issues.

1.05 SUBMITTALS

A. General: Comply with Section 20 05 00.

B. Product Data: Submit product data for duct lining, flexible duct, and factory fabricated items.

C. Conflict Resolution: Submit additional shop drawings showing proposed resolution of conflicts after review of documents and again after review of actual field conditions.

1.06 DUCT PRESSURE CLASS

A. Constant Volume Systems: Ductwork shall be constructed to the pressure class corresponding to the static pressure indicated for the fan which serves the duct system or 1-inch pressure class (plus or minus as appropriate), whichever is higher; unless noted otherwise.

1.07 REFERENCES

A. ADC-FLEX: Air Diffusion Council Flexible Duct Performance and Installation Standards.

B. ASHRAE-F: ASHRAE Handbook of Fundamentals.

C. ASTM A 653: Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

D. ASTM A 924: General Requirements for Steel Sheet Metallic-Coated by the Hot-Dip Process.

E. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.

F. IMC: International Mechanical Code.

G. NAIMA-DLS: North American Insulation Manufacturers Association Fibrous Duct Liner Standards, 1st Edition.

H. SMACNA-DCS: SMACNA HVAC Duct Construction Standards, 3rd Edition.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Paragraph 2.01, Acceptable Manufacturers.

B. Sheet Metal: All domestic manufacturers.

C. Spin-in Fittings and ATTO: Sheet Metal Connectors Inc., United McGill, Royal Metal Products, Airflow Products Inc.

D. Gasketing: Preson, Insulfab, Duraco.

E. Duct Sealant and Tape: Carlisle (Hardcast), Ductmate, Benjamin Foster, Grace Construction Products, United McGill, Polymer Adhesives Sealant Systems, RCD Corporation, Nashua, 3M.

F. Flexible Duct: Flexible Technology Inc., JP Lamborn Co.; Hart & Cooley, Thermaflex.

G. Acoustical Duct Lining: Johns-Manville.

2.02 GENERAL MATERIALS

A. Ducts: Construct of galvanized sheet steel, suitable for lock forming without flaking or cracking, conforming to ASTM A653 and A924, having a zinc coating of 0.90 ounces total per square foot for both sides of a sheet, corresponding to coating G90.

B. Fasteners: Steel construction, electroplated zinc coated, having strength properties adequate for the application, compatible with materials being joined, and in accordance with SMACNA-DCS. Where exposed to corrosive conditions shall be of Type 304 or 316 stainless steel. Type to meet duct pressure class and duct leakage requirements. Where used for the support and anchorage of ducts shall comply with Section 20 05 29, with independent test reports regarding strength.

C. Spin-in Fittings: Factory fabricated of galvanized steel with die-formed mounting groove and damper with raised damper quadrant where ducts are to be insulated. Collar length for flexible duct attachment shall be at least 2" long.

D. Air-Tight Take-Off Fittings (ATTO): Factory fabricated branch duct connector, of galvanized steel. Flange shall be 1-1/2” wide with 1/8” self-adhesive gasket and pre-drilled fastener holes. Collar length for flexible duct attachment shall be at least 2” long. Where used on round duct mains, shall be saddle type appropriately sized for main duct diameter.

E. Draw Bands:
   1. Metal: Worm gear type clamp, constructed of galvanized steel, stainless steel, or aluminum; minimum 1/2-inch wide band; suitable for 200 pound loading.
   2. Non-Metal: Nylon “zip-tie” with self-locking ability, designed for flexible duct usage, minimum 1/4 inch wide, rated for 175 pound load, suitable for temperatures from 0 to 185 deg F; listed per UL181B and labeled “UL181B-C”.

F. Gasketing: Vinyl nitrile, vinyl neoprene, or neoprene nitrile PVC blend; designed for HVAC use with size to suit the application having minimum 1.5-inch width at equipment roof curb applications. Fire hazard rating not to exceed 25 for flame spread and 50 for smoke development per ASTM E 84.

G. Duct Sealant/Mastic: Water based duct sealant, listed per UL 181B-M and UL 181A-M, suitable for indoor and outdoor use. Fire resistant with a flame spread rating of 5 or less, and a smoke developed rating of 0. Sealant shall be resistant to ultraviolet radiation and ozone. Fiberglass mesh shall be minimum 0.006-inches thick, with minimum 9x9 weaves per inch, and 2-inch width; for use with mastic in sealing ductwork. Sealant system shall be suitable for duct system pressure class and materials used with. Carlisle Hardcast “Versa-Grip 181”.

H. Foil Tape: Foil back adhesive tape, listed per UL181A-P and UL181B-FX, with listing labeled on tape outer foil face. Minimum 3-inch width for metal-to-metal applications; minimum 2-inch width for flexible duct applications. 3M No. 3340 or Nashua No. 324A.

2.03 DUCT FABRICATION

A. Duct Gauge and Reinforcement: Shall be as shown in SMACNA-DCS according to the pressure classification of the system and the duct dimensions; with heavier gauge duct used as required to minimize duct reinforcement to suit space available and other project constraints.

B. Joints and Seams: Construct in accordance with SMACNA -DCS, code requirements, and these specifications (more stringent governs). Ducts shall be constructed and sealed so that the leakage criteria is not exceeded. Round ducts shall be the spiral seam type; except that branch ducts to individual air inlets/outlets less than 16" diameter may be of other types as allowed by SMACNA-DCS. Coordinate joint spacing with duct reinforcement requirements so that transverse joints having the required stiffness may be incorporated in the reinforcement spacing schedule. Round duct transverse joints shall be made with beaded sleeve joints or flanged connections in accordance with SMACNA-DCS; except that branch ducts to individual air inlets/outlets less than 16" diameter may use other joining methods as a allowed by SMACNA-DCS.

C. Elbows and Tees: Shall be long-radius type with a center-line radius not less than 1-1/2 times the width or diameter of the duct. Where space does not permit the use of long-radius elbows, short-radius or square elbows with turning vanes may be used. Elbows in round duct systems with duct pressure class above 2-inches shall be stamped type, welded segmented type, or standing seam segmented type.

D. Transitions: Increase duct sizes gradually. Transitions for diverging air flow shall be made with each side pitched out not more than 22.5 degrees. Transitions for converging air flow shall be

made with each side pitched in not more than 30 degrees. Except that eccentric transitions for round to flat oval may have up to a 45 degree pitch.

E. Branch Connections: Shall comply with SMACNA-DCS, and as required herein.
   1. Rectangular-to-Rectangular: Rectangular take-off with 45 degree angle on “inside” of take-off, minimum 4" length. Reference SMANCA-DCS Figure 4-6. Close corner openings.
   2. Rectangular-to-Round:
      a. Serving Individual Air Inlet/Outlet: Spin-in type connector or air-tight take-off (unless a different fitting type is specifically noted).
      b. Serving Branch Duct: Rectangular to round transition, with maximum degree pitch as specified for transitions. Rectangular end size shall have free area no less than round end. Rectangular connection to rectangular main shall be made as specified for “Rectangular-to-Rectangular” connections.
   3. Round-to-Round:
      a. Other Connections: Air-tight take-off or constructed in accordance with SMACNA-DCS and recognized professional practices.
   4. Other Connections: In accordance with SMACNA-DCS and recognized professional practices.

F. Ductmate Systems:
   1. Rectangular Duct: Transverse duct joints may be made with Ductmate System, or approved equal. System shall consist of companion flanges of 20 gauge galvanized steel with an integral polymer mastic seal; corner pieces of 12 gauge G90 galvanized steel; 20 gauge G90 galvanized cleats; closed cell, high density gasket type; and galvanized carriage bolts with hex nuts. The flanges shall be securely fastened to the duct walls using self-drilling screws, rivets or spot welding. Fastener spacing shall be as recommended by the manufacturer for the size of duct and the pressure class. The raw duct ends shall be properly seated in the integral mastic seal. A continuous strip of gasket tape, size 1/4" x 3/4", shall be installed between the mating flanges of the companion angles at each transverse joint; and the joint shall be made up using 3/8-inch diameter x 1-inch long plated bolts and nuts. Galvanized drive-on or snap-on cleats shall be used at spacing recommended by the manufacturer.
   2. Round Duct: Transverse duct joints may be made with Ductmate “Spiralmate” system, or approved equal. System shall consist of galvanized steel round connector flanges (fitting inside each duct section to be joined) and an exterior galvanized steel closure ring with tightening bolt to form an airtight duct connection and join flanges together. Duct connector flanges shall have non-hardening integral mastic to seal between flanges and duct, and a neoprene gasket to seal flange faces.

G. Lined Ductwork:
   1. Rectangular Ducts: Contractor Fabricated ductwork with interior duct lining. Duct fabrication and liner installation shall comply with NAIMA-DLS. Lining material shall comply with paragraph titled “Duct Lining” in this specification section.
   2. Round and Oval Ducts: Shall consist of acoustic insulation in between a perforated interior duct liner and solid exterior duct. Acoustic insulation shall be 1-inch thick, except where noted to be greater. Duct sections shall connect by mechanical means to maintain positive concentricity of liner with duct. All fittings and transitions shall have perforated inner liner (except where noted otherwise). Lining material shall comply with paragraph titled “Duct Lining” in this specification section. United McGill "Acousti-k27" (or approved).

2.04 FLEXIBLE DUCT

A. Type: Factory insulated fully lined flexible duct.

B. Construction: Double-ply neoprene coated polyester fabric hose, reinforced with a steel wire helix. Black color. Fire hazard rating not to exceed 25 for flame spread and 50 for smoke development, as tested by ASTM E84.

C. Thermal Characteristics: Certified thermal resistance “R” of 4.2 Hr-SF-deg F/Btu, rated in accordance with ADC-FLEX. Except where duct is installed in an unconditioned area (and where required by code) provide certified thermal resistance “R” of 8 Hr-SF-deg F/Btu, rated in accordance with ADC-FLEX.

D. Working Pressure: As required to suit maximum pressure to be encountered on system, but no less than 4-inch wc positive, 0.5-inch wc negative.

E. Length: Shall not exceed 8 feet where used on duct systems with a pressure class of 2-inches and less; maximum 5 feet length on higher pressure class systems.

F. Code Compliance: Comply with code and applicable standards; including NFPA 90A, NFPA 90. Shall be UL listed and labeled as a Class 1 connector per UL 181.

2.05 DUCT LINING

A. Material: Flexible, inorganic glass fiber material, bonded with thermosetting resin, maximum thermal conductivity of 0.24 Btu-inch/hr-sq. ft.-degree F at 75 degrees F, coated to prevent erosion, conforming to NAIMA-DLS and exceeding that standard as specified herein. Suitable for air temperatures to 250 degrees F, and duct velocities to 6000 feet per minute. Surface shall be coated with an acrylic coating having anti-microbial agents and factory applied edge coating. Johns-Manville “Permacote Linacoustic” (or approved).

B. Thickness: Lining shall be 1-inch thick except where noted otherwise.

C. Adhesives and Fasteners: Shall conform to NAIMA-DLS, and as suitable for the duct liner material and ductwork.

D. Fungi and Bacteria Resistance: Conform to ASTM C 1338 and ASTM G21 for fungi resistance and ASTM G 22 for bacteria resistance.

PART 3 EXECUTION

3.01 DUCTWORK INSTALLATION

A. General: Install all ductwork with all accessories and connections to provide complete and operable duct systems, in accordance with plans and specifications. See Section 20 05 29 for hangers and supports. Provide quality assurance review of all drawings prior to beginning work (see paragraph titled Quality Assurance, this specification Section and see Section 20 05 00). Provide duct and plenum sizes and locations as shown on the drawings; except as adjusted for field conditions and work of other trades, and with prior approval of the Engineer. See Section 20 05 00 for offsets and transitions to be included in project.

B. Coordination: The Contractor shall fully coordinate the work of all trades to avoid interferences and conflicts. Due to the extremely tight spaces in portions of the building, the Contractor shall coordinate duct reinforcement spacing and supports with other trades as necessary to avoid interferences. In addition, the Contractor shall select duct gauge and reinforcement types to avoid interferences. Changes required due to lack of coordination between trades, improper spacing or selection of hangers, or improper duct gauge and reinforcement selection, shall be done at no additional cost to the owner.

C. Field Measurements: Prior to fabricating any duct materials, the Contractor shall field measure all areas where ducts will be installed to verify room available and all offsets and fittings required. Field verify connection sizes and locations to equipment, louvers, and similar items.

D. Workmanship: All work shall comply with code, SMACNA-DCS, and other applicable standards. Ducts shall be installed level (unless noted otherwise) and in neat lines with the building construction using best professional practices.

E. Exposed Ducts:
   1. All ducts are to be installed concealed unless indicated otherwise. Ducts that are exposed shall be carefully fabricated, stored, and installed for best appearance. All dents, dings, scratches and other damage shall be repaired for a high quality finished look; all dirt, debris, labels, stickers, lettering, and marks removed; and the duct completely cleaned. Any sealant shall be cleaned to form a straight and even seam adjacent to joints, have no overlap onto duct areas not needing sealant, and have all excess sealant removed (mask off adjacent areas as necessary).

F. Flexible Duct: May only be used where specifically shown on the plans. Attach flexible duct inner core to sheet metal duct (or connector) with draw band. For insulated type, pull insulation and outer jacket completely over the inner core (at the connection to the sheet metal duct) with outer jacket covering the inner core and tucked back at its end to provide a continuous vapor barrier cover; install draw band to secure the outer jacket and insulation. Use metal type draw bands on duct systems where duct pressure class exceeds 3-inches or where temperature or other conditions do not allow the non-metal type and where indicated; use type of metal suitable for the conditions without corrosion or other deterioration. Install flexible duct with a centerline turning radius not less than one duct diameter. Where this turning radius cannot be maintained with the flexible duct use sheet metal elbows or (at air inlets/outlets) provide a plenum having a side connection.

G. Spin-in Fittings/ATTO's: May be used for branch ducts to individual outlets only. Apply a bead of duct sealant to all spin-in fittings where fitting seals against sheet metal duct.

H. Sealing:
   1. General: Use materials listed and approved for the specific application. Foil tape may only be used at duct connections to air inlets/outlets (unless specifically noted otherwise). Clean surfaces to be sealed of moisture and all contaminants. Seal joints in accordance with SMACNA-DCS, sealant manufacturer's instructions, and UL 181.
   2. Ductwork: Seal to meet duct leakage criteria for Seal Class C.
   3. Flexible Duct: Coat connection of flexible duct to metal duct with duct sealant prior to installing the flexible duct.
   4. Air Inlets/Outlets: Seal duct connections (including "cans" or plenums) at air inlets and air outlets with duct sealant or foil tape; except at louvers and exposed ducts only sealant shall be used.

I. Ductmate: All "Ductmate" and similar systems shall be installed in strict accordance with manufacturer's instructions.

J. Protective Caps: Provide temporary sheetmetal caps or heavy visqueen covers over all open portions of ductwork to prevent debris, dirt, and dust from entering the ductwork. Such covers shall be installed at the end of each work shift, and shall remain in place until all work activities or events that may cause duct contamination will no longer occur.

3.02 ACOUSTICAL DUCT LINING INSTALLATION

A. General: Install acoustical duct lining in ducts to extent shown on drawings, covering all interior surfaces. Round ducts shall use factory fabricated double-wall ducts as specified.

B. Installation: Installation shall comply with NAIMA-DLS and these specifications. The liner shall be cut to assure tightly butted joints.

C. Liner Attachments: The duct liner shall be applied with a 100% coverage of adhesive. Mechanical Fasteners shall be installed flush with the liner surface, and shall be spaced in accordance NAIMA-DLS.

D. Horizontal Duct Runs: Tops of ducts over 12" wide and sides of duct over 16" high shall have liner additionally secured with mechanical fasteners.

E. Vertical Duct Runs: Any side of duct over 12" in size shall have liner additionally secured with mechanical fasteners.

F. Exposed Edges: All joints, exposed edges and any damaged areas of the liner, shall be heavily coated with fire resistant adhesive/mastic.

G. Metal Nosing: Install metal nosings on the leading edges of the liner in ducts where the velocity exceeds 4000 feet per minute.

3.03 PREPARATION FOR SERVICE

A. Cleaning: All ducts shall be wiped or blown clean of all dust and debris prior to the installation of grilles or diffusers. Notify the Engineer to allow for an inspection prior to installing grilles or diffusers.

B. Contaminated Ducts: Where ducts have been contaminated by dirt or debris during the construction process, the affected duct systems shall be cleaned by an independent firm specializing in the vacuum cleaning of ductwork. All costs associated with such cleaning shall be the responsibility of the Contractor.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Manual Dampers.

B. Backdraft Dampers.

C. Turning Vanes.

D. Security Grates.

E. Fire Dampers.

F. Duct Access Doors.

1.03 QUALITY ASSURANCE

A. General: Comply with Section 20 05 00.

B. Workmanship: Construction and installation of all duct accessories shall comply with applicable SMACNA-DCS, and exceed those standards as noted.

1.04 SUBMITTALS

A. General: Submittals shall comply with Section 20 05 00.

B. Product Data: Submit product information on all items to be used.

1.05 REFERENCES

A. AMCA 500D: Laboratory Methods for Testing Dampers for Rating.

B. SMACNA-DCS: SMACNA HVAC Duct Construction Standards, 3rd Edition.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Paragraph 2.01, Acceptable Manufacturers.

B. Manual Damper Hardware: Duro-Dyne, Young Regulator Co., Ventfabrics, Krueger, Rossi.

C. Backdraft Dampers: Air Balance, Ruskin, Greenheck.

D. Turning Vanes: Duro-Dyne, Aero-Dyne, Oil Capital Sheet Metal, Airsan.

E. Fire Dampers, Combination Fire/Smoke Dampers and Smoke Dampers: Ruskin, National Controlled Air, Air Balance, Greenheck.

F. Duct Access Doors: National Controlled Air, Ventfabrics, United-McGill, Kees, Ruskin, Vent Products, Duro-Dyne.

2.02 MANUAL DAMPERS

A. Type: Manually adjustable volume dampers.

B. Blades: Damper blades shall be fabricated of galvanized steel or stainless steel (unless a specific material is indicated), two gages heavier than duct in which installed, and in accordance with SMACNA-DCS. Maximum blade width 12 inches; fabricate multi-blade dampers with opposed blade pattern for ducts larger than 12" x 48".

C. Regulators: Damper regulator sets shall have quadrant dial regulator with locking nut, square end bearing one side, and spring round end bearing other side (small sizes) or open end square bearing (larger sizes), axis of blade the long dimension. Multiple blade dampers shall have individual quadrants for each blade or one quadrant with interconnected blades. Regulator sets shall be Duro-Dyne model numbers (or approved equal) as follows:

Max. Blade Dimension	Duro-Dyne Regulator Set	Shaft Size
10" and less	KS-145, 145L	1/4"
11" to 14"	KSR-195, 195L	3/8"
15" to 23"	SRS-388, SB-138, KP105	3/8"
24" and larger	SRS-128, SB-112, KP105	1/2"

D. Concealed Regulator: For remote damper adjustment with finished ceiling appearance. Shall consist of self-locking regulator of cast alloy construction (with serrated core, spring washer, housing, indicator, lock nut) cast into a cylindrical housing for flush ceiling installation. Housing cover shall be of steel construction, shall telescope into the regulator housing to be flush with the finished ceiling, and be secured to the housing with two screws. Provide with extension rods, linkages, miter gears, and all accessories as needed for proper damper operation. Plain Finish. Ventfabrics No. 666, 667 or Young Regulator Co. No. 301 (or approved equal).

E. Extractor Fittings: Galvanized steel construction, 24 gauge steel blades on 2 inch centers, with worm gear operator for adjustment through face of grille. Krueger EX-88 (or approved equal).

2.03 COUNTERBALANCED BACKDRAFT DAMPERS - LOW PRESSURE DROP

A. Type: Airflow and gravity operated backdraft dampers with adjustable counterbalance weight. Ruskin CBD6.

B. Frame: Shall be constructed of minimum 18 gauge galvanized steel or stainless steel or minimum 0.125-inch thick 6063T5 extruded aluminum (unless a specific material is indicated).

C. Blades: Shall be constructed of minimum 0.07-inch thick extruded aluminum, or formed stainless steel (unless a specific material is indicated), with extruded vinyl edge seals. Seals shall prevent any noise due to damper opening/closing. Bearings shall be synthetic polycarbonate or acetal or zytel type. Damper linkage shall be with aluminum or galvanized steel tiebar. Counterbalance weights shall be attached to blades, be of galvanized steel construction, and be adjustable.

D. Configuration: Horizontal or vertical airflow as indicated on plans.

E. Performance:

1. General: Dampers shall be tested in accordance with AMCA standards.
2. Temperature Rating: -40 to 200 degrees F.
3. Closed Position: Withstand maximum back pressure of 16 inches w.g.
4. Open Position: Withstand maximum air velocity of 2,500 feet per minute.
5. Operation of Blades: Start to open at 0.02 inch w.g.; fully open at 0.05 inch w.g.
6. Pressure Drop: Maximum 0.025 inch w.g. at 700 feeet per minute, maximum 0.15 inch w.g. at 1,500 feet per minute.

7. Dampers used to prevent the entry of outdoor air shall have air leakage no greater than 20 cfm/sf at 1-in w.g. where not less than 24-inches in any dimension, and no greater than 40 cfm/sf where less than 24 inches in any dimension; as tested in accordance with AMCA 500D.

F. Depth of Operation: Depth required to operate shall not exceed 10-inches.

2.04 TURNING VANES

A. Type: Galvanized steel turning vanes to guide airflow through duct elbows to minimize pressure drop.

B. Construction: Turning vanes shall comply with SMACNA-DCS. Vanes shall be fabricated of minimum 26 gauge galvanized steel; rails shall be fabricated of minimum 24 gauge galvanized steel. For duct widths less than 12 inches, vanes may be single wall construction; for widths 12” and greater, vanes shall be double wall "airfoil" type.

C. Spacing: Turning vanes shall be equally spaced in accordance with SMACNA-DCS, parallel to each other, and securely attached to runners.

D. Unequal Elbows: For elbows where the inlet and outlet dimensions are not the same, modify vane shape or angle to provide optimum turning.

2.05 SECURITY GRATES

A. Type: Wall mounted steel security grate, field welded in place.

B. Construction: 7/8-inch diameter hardened steel bars (minimum hardness of C-60 Rockwell), on 6-inch centers (horizontally and vertically) welded to 3/16-inch thick steel sleeve. Where horizontal and vertical bars cross they shall be welded to each other. Steel sleeve length shall match wall thickness sleeve is installed in and extend minimum 2-1/2 inches past the wall on each side. Sleeve shall have 1-1/2 inch x 1-1/2 inch x 3/16 inch steel angle frame factory welded to one side of sleeve and second angle frame (of same size) provided loose for field welding. Angle frame shall have vertical and horizontal angles fully welded to each other. Welding of angle to sleeve may be stitch type, minimum 1-1/2 inch long on 6-inch centers.

C. Sizing: Sleeve size shall be as indicated on the plans, and shall be larger than the connecting duct size as noted.

D. Finish: Two part polyurethane white prime coat finish.

2.06 CEILING FIRE DAMPERS

A. Type: UL classified ceiling radiation dampers for use in HVAC penetrations through fire rated ceilings, conforming to UL 555C.

B. Construction: Shall be factory fabricated of galvanized steel or stainless steel (unless a specific material is indicated). Provide thermal blanket to protect above ceiling exposed portion of ceiling diffuser. Thermal blanket shall be mineral wool or refractory ceramic fiber and be UL classified as a Ceiling Diffuser Radiation Shield.

C. Configuration: Shall be folding blade type, with blades in airstream, sized to match air inlet/outlet connected to. Free area in duct shall be at least 90% of nominal duct size area.

D. Operation: Dampers shall be spring operated to close when released by fusible link. Fusible link shall be set for 50 degrees F above maximum temperature expected in duct, but in case less than 165 degrees F.

2.07 DUCT ACCESS DOORS

A. Construction: Access doors shall be of double wall construction, made with minimum 24 gage galvanized steel, tight fitting, with sealing gasket, and cam locks (or may be hinged type with latches).

B. Size:
   1. General: Access doors shall be of sufficient size so that items concealed in duct can be serviced and inspected, and shall be adequately sized to allow complete removal of the item being served (where removal cannot be made without disturbing fixed ductwork).
   2. Minimum size: Doors shall be minimum 14" x 14". Where duct size will not accommodate this size door, the doors shall be made as large as practicable.
   3. Large Sizes: Doors larger than 14" x 14" shall have a minimum of 4 cam locks (or where hinged type is used, have a minimum of two (2) latches).

C. Insulation: Doors in insulated ducts shall be insulated type, with minimum 1 inch thick fiberglass insulation.

PART 3 EXECUTION

3.01 MANUAL DAMPERS

A. General: Dampers shall be fabricated and installed in accordance with SMACNA-DCS requirements for volume dampers.

B. Locations: Install dampers at locations shown on the drawings in branch ducts to all air inlets/outlets, and at all other locations as required by the Balancer to allow for the balancing of the system. Locate dampers at a point where the damper is most accessible; orient damper regulator for best access.

C. Non Accessible Dampers: Provide flush-mounted concealed type damper quadrants for ducts concealed in walls or non-removable ceilings and where a remote damper operator has been indicated.

D. Initial Setting: Set and lock all dampers in the full open position prior to balancing.

E. Extractor Fittings: Provide where indicated on the plans and at wall type inlets/outlets where such outlets cannot be served by a manual damper in the branch duct.

F. Identification: Provide orange surveyor’s tape, approximately 18” long tied to each damper regulator (except not required on dampers in ducts exposed to view in finished areas).

3.02 BACKDRAFT DAMPERS

A. General: Install in accordance with manufacturer's instructions.

B. Application: Use counterbalanced type at all non-fan powered building exhausts and reliefs; all others shall be the standard type.

C. Adjustments: Adjust counterbalanced backdraft dampers to be open at 0.07” building pressure (unless noted otherwise), or as necessary for proper space pressurization and building air balance. Coordinate work and settings with air balancer.

D. Access Doors: Provide access doors to backdraft dampers, except that where damper is installed immediately behind a ceiling or wall grille, and is accessible by removing this grille, an access door is not required.

3.03 TURNING VANES

A. General: Install turning vanes in all duct elbows and “T” fittings, and at locations shown on the drawings.

B. Attachment: Securely attach turning vane runners to ductwork.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Utility Set Fans.

B. Fan Accessories.

1.03 SUBMITTALS

A. General: Comply with Section 20 05 00.

B. Product Data: Submit manufacturer's product data for all items to be used. Submit fan curves showing SP vs. CFM and BHP vs. CFM with system operating point clearly marked.

1.04 QUALITY ASSURANCE

A. AMCA: Fans shall bear the AMCA certified seal unless indicated otherwise.

1.05 GENERAL REQUIREMENTS

A. Spare Parts: Provide two complete sets of spare belts for all belt driven fans.

1.06 REFERENCES

A. AMCA 99-0401: Classification of Spark Resistant Construction.

B. AMCA 210: Laboratory Methods of Testing Fans for Ratings.

C. IMC: International Mechanical Code.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. General: Products shall comply with Section 20 05 00. See Section 20 05 00, paragraph 2.01 for Acceptable Manufacturer requirements.

B. Exhaust Fans: Greenheck, Twin City, Penn Barry, Cook, Carnes.

C. Accessories: Fan manufacturers listed, NCA, Ruskin, Thybar, RPS.

2.02 GENERAL

A. Guards: All belt drives shall be equipped with belt guards, or enclosed within fan casing. Guards shall be factory fabricated and furnished with equipment, and comply with OSHA and WISHA regulations. Exposed openings into fan housings shall be protected with substantial metal screens or gratings.

B. Drives: Shall be sized for not less than 150% of the rated motor horsepower.

C. Adjustable Sheaves: All belt drive fans shall have adjustable sheaves and adjustable supports for adjusting belt tension. Sheaves shall be selected so that they are at their midpoint at design conditions.

D. Motors:
   1. General: Comply with Section 20 05 00. Motors on belt drive fans shall have adjustable supports for adjusting belt tension. Motor speed controllers shall be VFD type except where solid state speed controllers are provided or EC motors with integral speed controller. VFD's shall be as specified in Division 25.
   2. Fractional Horsepower Motors: Shall be the electronically commutated (EC) type with speed control where noted and where non-EC motors are not available which comply with code motor efficiency requirements. Unless noted otherwise, provide with manual speed control mounted at the motor for air balancers use. Motors shall be specifically designed for fan applications, have permanently lubricated ball bearings, speed controllable down to 20%, and have internal thermal overload protection.

E. Performance: Fan capacity shall not be less than the values listed on the drawings. Fan performance shall be based on laboratory tests conducted in accordance with AMCA 210.

F. Outlets and Inlets: Fans shall be furnished with attachment angles and/or flanges as required for attaching ductwork and/or flexible connections indicated.

G. Fan Types: The type of each fan is indicated on the Fan Schedule, under the "Type" column, and corresponds to the types specified herein.

H. Fan Arrangement and Drive: Shall be as indicated. Select motor and drive access side to allow best access and to suit available space.

I. Electrical: Fan disconnects and motor starters shall comply with Division 26 specifications. Disconnects furnished with fan shall come factory wired to motor or shall be field wired by Division 23.

J. Finish: All fans shall have factory applied enamel finish (manufacturer's standard color, unless noted otherwise) over a rust inhibiting primer base coat; except a painted finish is not required on rooftop type fans of aluminum or equivalent corrosion resistant construction.

K. Backdraft Dampers:
   1. General: Provide all exhaust fans with backdraft dampers.
   2. Rooftop Fans: Multi-blade backdraft damper, to close automatically to prevent airflow in the opposite direction than intended when fan is off, aluminum or galvanized steel construction (except shall be of stainless steel construction where duct system served is constructed of stainless steel). Frame shall be minimum 0.090-inches thick, with minimum 0.025-inch thick blades, synthetic bearings, concealed linkage connecting all blades, vinyl or felt blade edge seals, rated for 2500 feet per minute velocity, counterbalanced with adjustable weights to allow for proper operation. Leakage less than 10 cfm at 0.5-inch w.g. pressure differential for a 36-inch square damper. For installation in fan roof curb (unless indicated otherwise).

L. Weatherproof: Where installed exposed to weather, fans shall have weatherproof enclosure, preventing any wind driven water entry into unit or drive assembly.

2.03 UTILITY SET

A. Type: Centrifugal utility set type fan.

B. Housing Construction: Shall be constructed of minimum 16 gauge steel and shall be fully welded.

C. Fan Wheel: Shall be fully welded, with blade type (Backward Inclined Flat-Blade (BIF), Backward Inclined Air-Foil (BIA), Forward Curved (FC)) as indicated on the drawings.

D. Accessories:
   1. Cover: Provide weatherproof cover on units installed outside exposed to weather, and provide scroll drain.
   2. Support Assembly: Provide unit with integral support frame and base.
   3. Access Door: Provide with access door for fan cleaning.
   4. Coating/Finish: Where no special coating is specified, fan shall have factory enamel finish, manufacturer's standard.

E. Variable frequency Drives: Provide unit exhaust fan with VFD's where indicated on the plans.
   1. Variable Frequency Drives (VFD's):
      a. General: Where indicated, fans shall have variable frequency drives (VFD's). Acceptable manufacturers: ABB, Allen-Bradley, Reliance.
      b. VFD Type: Adjustable frequency and voltage variable speed controller, pulse width modulated type.
      c. Controller: Shall be housed in a NEMA 1 (or better) enclosure, and shall provide 6 to 60 Hz adjustable torque output. Standard Features:
         1) Start-stop speed selection.
         2) Manual speed potentiometer.
         3) Input fuses.
         4) Insensitive to incoming power phase sequence.
         5) Adjustable volts/Hertz.
         6) Output frequency stabilized to + 0.5% of set speed for +10% to -5% change in line voltage of 15 degrees C change in ambient temperature.
         7) Three-phase output voltage regulated to + 1% of rated voltage with +10% to -5% variations in plant power.
         8) Standard off-the-shelf, NEMA B and synchronous motors (3600, 1800, 1200 rpm) usable without derating controller.
         9) Automatic shutoff under output short circuit conditions or when load current exceeds 150% of maximum output amps (RMS).
         10) Input fuses.
         11) Line transient protection to prevent power line transients from harming the controller.
         12) Relay contact to provide external signal for alarm and run condition.
         13) Monitor lamps (or LCD display) indicating: power on, zero speed, enabled, unit failure (with type indicated).
         14) Hand-Off-Auto switch.
         15) Auto restart after power outage.
         16) Isolated Process Control Follower - accepts 0 to 5 mA, 1 to 5 mA, 4 to 20 mA, 10 to 50 mA, 0 to 10 V D-C or 25 to 250 V D-C signal.
         17) Input Disconnect (meeting NEC requirements for unit power disconnect).
         18) Output Contactor - for positive motor disconnect.
         19) Output Overloads - using individual phase bimetallic thermal sensors.
         20) Ammeter - ampere scale depending upon drive rating.
         21) Voltmeter - 0 to 500 volt (460 volt drives); 0 to 750 volts (575 volt drives).
         22) Frequency Meter - 0 to 120 Hz scale.
         23) Manual Bypass - To switch the motor to or from the controller to the line.

d. VFD shall be for use with specified equipment. Unit shall accept appropriate control signal from the Section 23 09 33 control system and provide for variable speed operation of unit served.

e. System shall be fully compatible with motors furnished, and shall be free of audible noise exceeding an NC of 45 in any octave band.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Comply with Section 20 05 00. Install in accordance with manufacturer's written installation instructions, code, applicable standards and best construction practices.

B. Locations: Install fans at locations indicated and in accordance with the Contract Documents.

C. Speed Controls: Fans with speed controllers shall have the speed controller mounted on the fan housing unless another location is indicated on the drawings (for use by Balancer).

D. Connections: Provide flexible connections in ductwork connections to all fans.

E. Rooftop Type Fans: Rooftop type fans shall be mounted on sleepers, secured to sleepers on all sides, and sealed watertight.

F. Vibration Isolation: Install all fans with vibration isolators so that no sound or vibration is transmitted to the structure; except not required for rooftop type fans. See Section 20 05 48 for vibration isolation specifications.

G. Owner Instruction: Instruct Owner on the operation of each fan, including: system start-up, shut-down, emergency shut-down, normal control operation, safety aspects, maintenance and repair instructions.

H. Start-Up: Prior to start-up inspect fans and installation to confirm proper installation and system is ready for start-up. Arrange other trades to be present as needed (i.e. balancer, electrician, etc.). Check fans for correct rotation, tighten belts to proper tension, adjust fan speeds to provide required performance, verify proper electrical and control connections, check vibration isolation (as applicable) for correct operation, and lubricate bearings per manufacturer's recommendations.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. GRD Outlets.

B. GRD Inlets.

1.03 DEFINITIONS

A. GRD's: Grilles, Registers, and Diffusers.

1.04 REFERENCES

A. AHRI 885: Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

B. AMCA 500: Laboratory Methods of Testing Louvers for Rating.

C. ASHRAE 70: Method of Testing the Performance of Air Outlets and Air Inlets.

D. ASHRAE-F: ASHRAE Handbook of Fundamentals.

E. SMACNA-DCS: HVAC Duct Construction Standards, 3rd Edition.

1.05 SUBMITTALS

A. General: Comply with Section 20 05 00.

B. Product Data: Submit product information for all items to be used.

C. Operation and Maintenance: Submit operation and maintenance data and submittal data for inclusion in project O&M Manuals.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00, Paragraph 2.01, Acceptable Manufacturers.

B. Grilles, Registers and Diffusers: Titus, MetalAire, Krueger, Price, Tuttle & Bailey, Kees, Carnes.

2.02 GENERAL REQUIREMENTS

A. Type: Air outlets and inlets shall be of the size, type, and with number of throws as shown on the drawings; and shall match the appearance and performance of the manufacturers' models specified and scheduled on the drawings.

B. Performance: Air outlet and outlet performance shall be based on tests conducted in accordance with ASHRAE 70.

C. Sound Level: Air outlets and inlets shall not exceed a sound level of NC 30 for the size indicated and airflow rate application. Sound levels shall be determined in accordance with AHRI 885 and ASHRAE-F.

D. Finish: Grilles, Registers and Diffusers shall have factory applied finish, color as selected by Architect/Engineer, except where indicated to have a brushed aluminum finish (or other finish type). Finish shall be an anodic acrylic paint, baked on, with a pencil hardness HB to H. Pint shall pass a 90 hour ASTM B117 salt spray test, 250 hour ASTM D870 water immersion test, and an ASTM D2794 reverse impact test with at least a 50 inch-pound force applied.

E. Frame Style: Provide air outlets and inlets with frame style to match ceiling or wall construction installed in. Where supply air outlets or inlets are installed in T-bar ceiling systems, they shall be factory installed in 2' x 2' or 2' x 4' metal panel to match ceiling layout. Where installed against gypsum board surface, brick or similar hard surface, or where exposed, provide with 1-1/4-inch wide outer border. Where space does not permit installing 2' x 2' metal panel, provide outlets or inlets with 1-1/4-inch wide outer border. Where air outlets are installed adjacent to surface mounted light fixtures, outlets shall have 4-inch deep drop frames. (See reflected ceiling plan and/or electrical lighting plan for ceiling and lighting types).

F. Transfer Grilles: Ceiling transfer grilles shall be same as ceiling exhaust grilles (CEG) unless noted otherwise; wall transfer grilles (WTG) shall be same as wall exhaust grilles (WEG) (unless noted otherwise).

G. Construction: Air outlets and inlets shall be of steel or aluminum construction except that:
   1. Where noted to be constructed of a specific material, shall be as noted.
   2. In assemblies with a required fire rating and required to have fire dampers shall be of steel construction.
   3. In wet areas or subject to condensation (i.e., locker rooms, restrooms, kitchens, exterior soffits, etc.), where not used in fire rated assemblies, shall be of aluminum construction.
   4. Air outlets and inlets in the same room, area, or within common view shall be constructed of the same material.

H. Security Grille Fasteners: Where fasteners are required on security grilles they shall be the Torx type, with head center pin, minimum 1/4-inch diameter, and length to allow fastener anchoring to building structure. Where grilles are anchored by welding additional fasteners are not required.

2.03 SUPPLY AIR OUTLETS

A. Ceiling Diffuser (CD): Aluminum or steel construction, modular core, with multiple curved (or angled) discharge blades, and square neck. Cores shall consist of four separate sections which can be repositioned to allow for one, two, three or four way discharges. Cores shall be easily removed with no tools required. Krueger 1240 Series, Titus MCD, MCD-AA Series (or approved equal).

2.04 SUPPLY AIR OUTLETS – SECURITY TYPE

A. Ceiling Diffuser – Security (CD-S): Louver face supply diffuser, steel construction, throw pattern as noted on plans, with 12 gauge steel face plate. Face plate shall have 13/16-inch square holes on 1-inch centers, with 3/16-inch diameter holes for anchoring. Provide with 1-1/2” x 1-1/2” x 3/16” steel angle framer with welded on nuts for anchoring through face of grille to angle frame. Titus SG-TDC.

2.05 RETURN AND TRANSFER AIR INLETS

A. Ceiling Transfer Grille (CTG): Aluminum construction, "cube-core" or "egg-crate" type, with 0.025-inch thick x 1/2-inch deep strips mechanically joined to form 1/2" x 1/2" x 1/2" cubes. Krueger Series EGC5. Titus Series 50F.

B. Filter Return Grille (FRG): Same as CTG but configured to accept a 2-inch thick filter, same size as grille neck. Grille face shall be hinged and require no tools to open. Titus 50FF.

2.06 EXHAUST AND TRANSFER AIR INLETS – SECURITY TYPE

A. Ceiling Exhaust Grille – Security (CEG-S): Constructed of 12 gauge steel, with faceplate having 13/16” square holes on 1” centers, 1-3/4” border, and 3/16” diameter screw holes for mounting. Provide with 1-1/2” x 1-1/2” x 3/16” rear mount steel angle frame with welded on nuts for anchoring through face of grille to angle frame. Provide with opposed blade damper. Titus SG-LFO.

B. Ceiling Transfer Grille – Security (CTG-S): Same as CEG-S but without an opposed blade damper.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install air outlets and inlets in locations indicated and so as to conform with building features and coordinated with other work. See hangers and supports specification Section for supports and additional requirements.

B. Location Verification: Verify all air inlet/outlet locations with building features and other trades prior to installing any duct systems that will connect to the air outlets/inlets. For locations where air inlet/outlet location is noted to be verified, or location is not clear, develop shop drawings showing the proposed location, or the location that best suits field conditions, and submit for review.

C. Connections: Furnish all necessary screws, clips, duct collars, and transitions required to allow for the installation and connection of ductwork to all air outlets/inlets. Connect all ductwork to air inlets and outlets with fasteners, minimum one each side and in compliance with SMACNA-DCS. See ductwork specification Section for sealing and additional requirements.

D. Painting:
   1. Paint ductwork and accessories which are visible behind air outlets and inlets flat black. Painting to include ductwork, duct liner, turning vanes, liner attachments, and all visible items (including fastening pins for duct lining).
   2. Coordinate with the Division 09 Contractor for any necessary painting of air outlets/inlets/louvers prior to installation.

E. Grilles, Security Type: Bolt through face of grille to angle frame above ceiling to “sandwich” building construction between grille faceplate and angle frame.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 and Division 1 Specification Sections, apply to this Section.

B. Requirements of Section 20 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Single Package Air Source Heat Pumps.

B. Unit Roof Curbs.

1.03 SUBMITTALS

A. Product Data: Submit product information on all units; including performance data showing cooling and heating capacity (as a function of indoor and outdoor coil db/wb temperatures and indoor coil air flow rates), supplementary heater capacity, fan performance, filter information, unit accessories, wiring diagram, and point of connection of all utilities.

B. Installation: Submit manufacturers installation instructions for units.

1.04 QUALITY ASSURANCE

A. Listing: Units shall be UL listed and labeled.

B. Performance Ratings: Units' cooling and heating performance shall be rated in accordance with ANSI/AHRI 210/240.

C. Codes: Unit and accessories shall conform to applicable codes and standards. Unit efficiency shall comply with code (and exceed code as indicated).

D. Operating Ability: Unit and all components shall be able to withstand ambient temperatures from 0 deg F to 125 deg F, plus direct exposure to sun and weather elements without adverse effects. Unit shall be able to operate and produce cooled air between ambient temperatures of 45 deg F and 115 deg F. Unit shall be able to operate and produce heated air between ambient conditions of 0 deg F and 80 deg F. Unit shall be able to operate with supply air temperatures between 50 deg F and 125 deg F; and with room temperature setpoints between 65 deg F to 85 deg F.

E. Electrical: Coordinate equipment electrical voltage/phase, minimum circuit amps, and overcurrent protection requirements with the Division 26 contractor prior to ordering.

1.05 GENERAL REQUIREMENTS

A. Extended Warranties: Unit compressors shall be warranted by the manufacturer for five years. All labor and materials associated with compressor replacement (or repair) shall be warranted.

B. Spare Parts:
   1. Belts: Provide two complete sets of spare belts for all belt driven fans.
   2. Filters: Provide two complete spare sets of filters for each unit.

1.06 REFERENCES

A. ANSI/AHRI 210/240: Performance Rating of Unitary Air Conditioning & Air-Source Heat Pump Equipment.

B. ANSI/AHRI 270: Sound Rating of Outdoor Unitary Equipment.

C. ANSI/ASHRAE 52.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products shall comply with Section 20 05 00. See Section 20 05 00, paragraph 2.01 for Acceptable Manufacturer requirements.

B. Heat Pumps: Trane, Carrier, York/JCI.

2.02 SINGLE PACKAGED HEAT PUMPS – 5 TON AND SMALLER

A. Type: Single packaged air to air heat pump. Configuration as shown on drawings.

B. Capacity: Units shall have minimum cooling and heating capacities as scheduled on the drawings at the conditions shown.

C. General: Units shall be fully factory assembled and shall be complete with casing, coils, fans, compressor(s), piping, wiring, controls, supplementary electric heaters and all other accessories required to be ready for field connections and operation.

D. Refrigerant: Units shall be for use with refrigerant R-410A and shall be fully charged at the factory.

E. Unit Casing: Shall be constructed of zinc coated steel, with baked-on enamel finish. Access panels shall provide access to unit controls, indoor coil, supply air fan, outdoor fan, compressor, and all items requiring service. Indoor air section shall be completely insulated with minimum 1/2" thick 1-1/2 lb. per cubic foot neoprene coated fiberglass insulation. Insulation in the evaporator section shall have cleanable foil faced insulation. All screws or holding devices shall be of cadmium plated construction to resist corrosion. Unit shall have knockouts for utility and control connections with rubber grommets to insure water-proof connections. Casing below indoor air coil shall have condensate drip pan with drain connection to outside with PVC P-trap.

F. Compressor(s): Direct drive hermetically sealed or serviceable hermetic, scroll or reciprocating type, specifically designed for heat pump service. Compressor shall have internal line break overcurrent and overtemperature protection, low pressure protection, internal high pressure relief or high pressure switch, anti-short cycle timer, and crankcase heaters. Compressors shall be mounted on vibration isolators.

G. Refrigerant Circuit: Shall be fully factory piped and shall include a refrigerant line filter/drier, service pressure tap ports, reversing valve, accumulator, and thermostatic expansion valve (or dual flow metering device) for both heating and cooling operation.

H. Coils: Shall be constructed of seamless copper tubing with aluminum fins mechanically bonded to tubes. Evaporator coils shall be factory leak tested to minimum 200 psig; condenser coils shall be factory leak tested to minimum 400psig.

I. Coil Drain Pan: Constructed of non-corrosive material, dual sloped to drain, reversible and removable.

J. Fans:
   1. General: Shall be statically and dynamically balanced at factory.
   2. Evaporator Fan: Shall be centrifugal type, with belt drive or minimum three-speed direct drive motor. Motor shall be permanently lubricated type with built-in auto-reset thermal

overload protection. Bearings shall be sealed permanently lubricated type. Belt drive fans shall have quick adjust fan motor mounting plate or adjustable idler-arm assembly for easy belt tension adjustment. Sheaves shall be the adjustable type on belt driven units.

3. Condenser Fan(s): Shall be propeller type, used in draw-through configuration. Fan shall be direct drive, with permanently lubricated totally enclosed weather-proof motor(s) having built-in auto-reset thermal overload protection. Fan shall have controls to cycle as needed to maintain proper refrigerant system pressures/temperatures at the outdoor coil.

K. Filters:

1. General: Units shall be provided with filter racks for accommodating 2" thick filters (unless noted otherwise), with minimum filter area (or sizes) as scheduled. Access panels to filters shall be hinged, with latches (or equivalent device) requiring no tools to open.
2. Filter Type: Shall be pleated panel, disposable type. Filter shall have MERV 8 efficiency as evaluated by ASHRAE 52.2.

L. Defrost: Unit shall have defrost cycle to remove build-up of frost on outdoor coil. Defrost cycle shall be time and temperature initiated, i.e. after 90 minutes (adjustable to lower time periods) elapsed run time if temperature is low enough defrost cycle shall be activated. Defrost cycle shall be time or temperature terminated, i.e. defrost cycle shall stop after 10 minutes or when refrigerant temperature is high enough indicating defrost is completed. When in defrost mode unit supplementary electric heaters shall be activated automatically.

M. Supplementary Electric Heaters: Shall be provided with capacity as scheduled on the drawings at the voltage and phase indicated. Heaters shall have open wire nickel-chrome elements, and safety overcurrent and overtemperature protection. Heaters shall be UL listed.

N. Electrical Power: Units shall be for use with power of voltage and phase as scheduled on the drawings. Units shall have single source power entry unless indicated otherwise. Units with single source power entry shall require only one field connection and power source. All necessary terminal blocks, fuse blocks, fuses, wiring, junction boxes and accessories shall be factory installed within the unit cabinet to provide power to all devices (including the supplementary heater for single source power entry units.)

O. Economizer Dampers – Factory:

1. General: Unit shall have economizer dampers manufactured by unit manufacturer to allow use of 100% outside air for economizer cooling. System shall have outside air and return air dampers, each operable from 0% to 100% of unit total airflow capacity. Dampers shall have linkage to allow return air damper to close as outside air damper opens. Outside air inlet shall have an aluminum mesh water entrapment filter and intake hood.
2. Powered Exhaust: Where indicated on the plans, unit shall have powered exhaust with fan sized to exhaust no less than 80% of unit supply air. System shall include exhaust fan, exhaust hood, and exhaust fan, backdraft damper. Fan shall be direct drive centrifugal type, with permanently lubricated bearings, EC motor with speed controller and thermal overloads. Controls shall be configured to allow operation of fan by Section 23 09 33 control system.

P. Controls:

1. General: Unit control shall be by Section 23 09 33 (unless noted otherwise); unit shall have limited factory controls to provide necessary safeties and to allow for control by Section 23 09 33. Section 23 09 33 shall control unit supply fan, cooling, heating, supplementary heating, damper positions, and economizer function. Unit condenser and defrost operation shall be by unit factory controls. Unit shall be furnished with all necessary relays, starters, wiring terminal strips, timers, safety devices, etc. to allow for the sequence of operation as specified in Section 23 09 33 using the Section 23 09 33 control system. Unit wiring shall be color coded and numbered corresponding to unit's

wiring diagram. Access panels to unit controls shall be hinged with latches (or equivalent device), requiring no tools to open.

2. Supply Fan/Cooling/Heating Controls: Shall be by Section 23 09 33. Unit shall have terminal strip (and associated wiring/devices) for connection of Section 23 09 33 wiring to allow for control by Section 23 09 33, as specified in Section 23 09 33 and as follows:
   a. Supply fan operation when “common” and “fan” terminals are interconnected (by the Section 23 09 33 control system).
   b. Cooling operation when “common” and “compressor” and "common" and "reversing valve" terminals are connected (by the Section 23 09 33 control system). Provide “compressor 1”, “compressor 2”, "reversing valve 1", etc. terminals to match number of compressor cooling stages for units with multiple stages of cooling.
   c. Heating operation when “common” and “compressor” and "supplementary heater" terminals are connected (by the Section 23 09 33 control System). Provide "compressor 1", Compressor 2", “supplementary heater 1”, “supplementary heater 2”, etc. terminals to match number of heating stages for units with multiple stages of heating.
3. Economizer Controls: Unit damper actuators, economizer logic, and controls for relief fan speed control operation shall be by Section 23 09 33 controls.
4. Control Safeties: In addition to code required safeties, unit shall have safety controls to prevent operation that may be unsafe or damage the unit. Such safeties shall as a minimum include controls of all refrigeration system components, low refrigerant pressure safety, and high refrigerant pressure safety.
5. Ambient Controls: Unit shall have all necessary safeties and controls to allow operation at the specified ambient and room conditions.

Q. Roof Curb: Factory fabricated heavy gauge steel curb, with horizontal base foot, top wood nailer wrapped over top with top of steel curb, and top gasket seal. Size, configuration, and capacity to match equipment served and roof slope installed on. Curb shall provide level watertight mounting surface for equipment served, and shall have provisions for seismic anchoring of unit to curb, and curb to building structure.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Comply with Section 20 05 00. Install in accordance with manufacturer’s written instructions, code, applicable standards and best construction practices. Care shall be taken when moving and setting units not to damage roof, curb, units, or other items.

B. Location Verification: Install equipment at locations indicated in accordance with the Contract Documents. Prior to selecting installation locations and setting unit curb and unit, confirm that: unit curb properly matches building support structure; curb is level and dimensionally matches unit; installed duct locations match unit connection locations; manufacturer's pre-installation checklists have been completed; proper unit clearances and access will be provided; proper distances from plumbing vents and other vents; no adverse airflow conditions are present; and installation has been coordinated with other trades.

C. Gasketing: Provide gasketing around top of unit curb and where duct connections mate to unit.

D. Complete Connections: Connect and install all items shipped loose with units; provide and connect all utilities and accessories as required for proper unit operation.

E. Refrigerant Charge: Units shall be checked for proper refrigerant charge and oil level and re-charged as necessary. Refrigerant shall be delivered to the site in factory charged containers and charged into the system through a filter/drier.

F. Sheaves: Provide sheave changes for all belt driven fans. Sheave changes shall be as directed by the Balancer or Engineer requirements.

G. Cleaning: Units shall be thoroughly cleaned (internally and externally) of all debris prior to operation. Units shall be clean and in new condition prior to Owner acceptance.

H. Operation and Maintenance:
   1. General: Operation and Maintenance shall be in accordance with manufacturer's written procedures and recognized best maintenance practices. Keep records of maintenance and (upon request) forward to the Architect/Engineer prior to project final acceptance.
   2. Stored Products: Provide maintenance (i.e. equipment rotation, lubrication, flush, cleaning, etc.) and inspection on products while stored to maintain new condition.
   3. Installed Products: Provide maintenance and inspection of products and operate mechanical systems until substantial completion or specified Owner Instruction has been provided (whichever is later). Maintenance shall include all manufacturer's recommended maintenance (i.e. strainer cleaning, filter changes, bearing lubrication, belt tensioning, etc.). In addition to scheduled maintenance, review all equipment periodically to allow detection of improper operation or any special maintenance needs; review shall be consistent with best practices for the product but in no case less than every two weeks.
   4. Units shall not be operated until all construction activities that generate dust, dirt, fumes, or odors are complete. Units shall not be placed into service until start-up has been completed.

I. Owner Instruction: Instruct Owner on equipment operation, including: system start-up, shut-down, emergency shut-down, normal control operation, safety aspects, maintenance and repair instructions.

3.02 START-UP

A. Pre Start-Up Inspection: Inspect equipment and connecting systems to confirm equipment and connecting systems to confirm equipment has been installed properly and is ready for start-up. As a minimum, check for: proper voltage and phases, correct system refrigerant charge, correct electrical connections, complete control connections, all unit safety devices properly set and connected, heaters operational, fans free to rotate and rotating correctly, fans lubricated, belts tightened to proper tension, coils clear of obstructions, and other items as listed by the manufacturer are properly provided/connected and operating to ensure safe and proper start-up. If items are discovered that prevent start-up to be completed, notify the installing Contractor and Engineer of issues. Coordinate and re-schedule start-up after items are corrected.

B. Start-Up: Perform start-up in accordance with manufacturers written start-up procedures. Arrange other trades needed to be present (i.e. balancer, control technician, etc.). Operate equipment in various modes to confirm proper operation. Observe proper operation of all unit components (heating, cooling, condenser fan, economizer, etc.).

C. Adjustments: Adjust and set unit components to allow for proper operation (i.e. adjust fan sheaves, adjust fan speeds, unit settings, etc.). Observe unit to detect any unusual vibration, leakage, loose wiring, or other situations that could affect unit operation.

3.03 COMMISSIONING

A. General: The Products referenced in this section are to be commissioned. The Contractor has specific responsibilities for scheduling, coordination, testing, and documentation of the commissioning. The Contractor shall provide a documented and signed record to verify that all equipment and systems installed under this contract have been inspected and functionally tested to verify full compliance with the contract specifications. See Section 20 08 00.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes materials, equipment, labor, supervision, tools and items necessary for the construction, installation, connection, testing and operation of electrical work. This section applies to all Divisions 26, 27, and 28 sections.

B. General Requirements: General Conditions, Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 CODES AND STANDARDS

A. Perform work in accordance with requirements of the state in which the work is performed.

B. Conform to applicable industry standards, UL standards, NEMA standards, and other standards as noted.
   1. Notify the A/E of deviations in Contract Documents to applicable codes and ordinances prior to installation of the Work. Perform changes in the Work after initial installation due to requirements of code enforcing agencies at no additional cost to the Owner.
   2. If conflict occurs between legally adopted codes and the Contract Documents, the codes prevail, except that this shall not be construed as relieving the Contractor from complying with requirements of the Contract Documents which may exceed code requirements and not contrary to same.

C. Operating Conditions:
   1. Temperature: Minus 20 deg C to plus 40 deg C.
   2. Altitude: Up to 3,300 feet (1,000 meters).

1.03 PERMIT INFORMATION

A. Permit Application: Arrange for and pay for all required permits, fees, and inspections required for work included in Division 26, 27, and 28.

B. Permit Submittal Plan Review: Submit the following to the AHJ as required to support the permit application:
   1. Fire Alarm Permit: Submit Shop drawings

C. Approved Permit Plans Printing: Print and have available for the inspector a full size color set of the approved plan review drawings. A digital set of approved drawings will be provided electronically and will be the same size and sheet count as the Bid Documents.

1.04 SUBMITTALS

A. Comply with requirements in Division 01 and with additional requirements indicated in this article.

B. Electronic Product Data:
   1. Comply with requirements in Section 013300 and additional requirements indicated in this article.
   2. Submit each specification section complete at one time with a dedicated submittal number for each section. For example, submit products for Section 260519 under one submittal number and products for Section 260533 under a different submittal number. Submitting multiple sections at one time acceptable as long as each section has a dedicated submittal number. Include submittal number and date submitted in file name.

3. Submit signed letter indicating 3D model coordination has started and will continue through construction. 3D model not required to be submitted/reviewed during construction phase.
4. Partial product submittals not acceptable and will be returned without review except as follows:
    a. Section 260573 Power Studies including representative one-line diagram of distribution system (with bus numbers as described herein) indicating which devices will be presented in protective device coordination study and indicate additional information required to complete the study.
    b. Section 260923 Lighting Controls including products and materials for first submittal and Shop Drawings for second submittal.
    c. Sections 265100 Lighting and 265561 Stage Lighting Systems including products and materials for first submittal and Shop Drawings for second submittal.
    d. Section 283111 Fire Alarm and Detection Systems including products and materials for first submittal and Shop Drawings for second submittal.
    e. Long lead items.
    f. Site and underground work.
5. Clearly mark catalog pages, equipment, and model number to be used. Indicate associated specification section and paragraph number on each page. Identify required options and accessories.
6. Format:
    a. Adobe PDF file format.
    b. Bookmark each submittal to facilitate browsing to each specification paragraph number.
    c. Include table of contents for each specification section. Include catalog numbers or drawing numbers.
    d. Include the Contractor and manufacturer's representative contact information for each product. Include job name (or abbreviation of job name), specification number, and contractor submittal number in file name.

C. Shop Drawings:
1. Submit as specified in the individual specification sections. Submit minimum 30 days prior to starting fabrication on installation work. Do not fabricate on install until reviewed by the A/E. Include complete location dimensions, and hanger and support sizes and dimensions.
2. "Typical" drawings and wiring diagrams not accepted unless they specifically apply to this project.
3. Drawings shall be drawn at sufficient scale to show details clearly on same size sheets as Drawings.
4. Show required coordination with work of other trades.
5. Identify details and show their locations in Project.
6. Include description of configuration and operation of proposed systems.
7. Include outline drawings of proposed equipment in plan and elevation views including overall dimensions, weights, and clearance required.
8. Include one-line electrical diagrams required for control and sensing.
9. Floor plan backgrounds are available in electronic format and shall be requested from the A/E.
10. Direct use of the Drawings as the basis of Contractor's prepared Shop Drawings not acceptable.

11. Format:
    a. Adobe PDF file format.

D. Approval: Approval of a manufacturer's name or product by the A/E does not relieve the Contractor of the responsibility for providing materials and equipment which comply in detail with requirements of the Contract Documents.

E. As-Built Drawings: Daily updates and markups that reflect all changes made in the specifications and working drawings during the construction process, and show the exact dimensions, geometry, and location of all elements of the work completed under the contract.

F. Re-Submittals: Clearly identify re-submittals. Provide revised tabs, indexes, page renumbering, and other formats to interface with original submittal. Identify changes and include date for project tracking.

G. Test reports and Certificates: Submit as a package prior to Substantial Completion.

H. Certifications: Submit written certifications from the governing building authorities stating that work has been inspected and accepted, and complies with applicable codes and ordinances.

I. Record Drawings: Conformed set of as-builts developed during the construction process. Drawings shall be a single digital copy for each sheet in the contract documents and developed at the end of the construction phase. Comply with Article "Record Drawings" in this section.

J. Schedule of Values:
    1. Comply with the requirements in Division 01 with additional requirements as indicated in this paragraph.
    2. Include costs in Schedule of Values as follows:
        a. Mobilization.
        b. Submittals.
        c. Electrical Permit.
        d. 3D Coordination
        e. Lighting Systems – Fixtures & Lamps Material.
        f. Lighting Systems – Fixtures & Lamps Labor.
        g. Lighting Systems – Branch Circuit Raceway Rough-in, Material.
        h. Lighting Systems – Branch Circuit Raceway Rough-in, Labor.
        i. Lighting Systems – Branch Circuit Wiring, Material.
        j. Lighting Systems – Branch Circuit Wiring Labor.
        k. Lighting Systems – Devices & Trim, Material.
        l. Lighting Systems – Devices & Trim, Labor.
        m. Power Systems – Equipment Connections.
        n. Power Systems – Branch Circuit Raceway Rough-in, Material.
        o. Power Systems – Branch Circuit Raceway Rough-in, Labor.
        p. Power Systems – Branch Circuit Wiring, Material.
        q. Power Systems – Branch Circuit Wiring, Labor.
        r. Power Systems – Devices & Trim, Material.
        s. Power Systems – Devices & Trim, Labor.
        t. Low Voltage – Fire Alarm Rough-in, Material.
        u. Low Voltage – Fire Alarm Rough-in, Labor.
        v. Low Voltage – Fire Alarm Trim, Material.
        w. Low Voltage – Fire Alarm Trim, Labor.
        x. Low Voltage – Telecommunications Pathway Rough-in, Material.

y. Low Voltage – Telecommunications Pathway Rough-in, Labor.
z. Low Voltage – Telecommunications Cabling, Material.
aa. Low Voltage – Telecommunications Cabling, Labor.
bb. Low Voltage – Security Video, Material.
cc. Low Voltage – Security Video, Labor.
dd. Punch List and Close Out.
ee. Testing Commissioning and Training.

1.05 DEFINITIONS AND ABBREVIATIONS

A. Refer to Division 01 for definitions and abbreviations. Additional definitions and abbreviations are as follows.

B. “Approved” or “Approval” means written approval by the owner or “Owner’s agent” (A/E).

C. “Codes” means AHJ adopted codes, rules, and ordinances and additional codes as specified herein.

D. “Concealed” means spaces out of sight. For example, above ceilings, below floors, between double walls, furred-in areas, pipe and duct shafts, and similar spaces.

E. The word “Contractor”, as used in Divisions 26, 27, and 28 sections, means the electrical subcontractor.

F. “Coordination”, “Coordinating”, and “Coordinate” means to bring, or the bringing, into a common action, movement, or combination so as to act together in a smooth concerted way.

G. “Directed”, “Requested”, “Accepted”, and Similar Terms means these terms imply “by the A/E” unless otherwise indicated.

H. “Exposed” means open to view. For example, raceways installed in a tunnel or raceways installed in a room and not covered by other construction.

I. “Furnish” means supply and deliver to the project site ready for unloading, unpacking, assembly, installation, and similar activities.

J. “Indicated” and “Indicated on the Drawings” means shown on Drawings by notes, graphics or schedules, or written into other portions of Contract Documents. Terms such as “shown”, “noted”, “scheduled” and “specified” have same meanings as “indicated”, and are used to assist the reader in locating particular information.

K. “Install” means to place in position for service or use. Includes operations at project site, such as unloading, unpacking, assembly, erection, placing, preserving, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar activities.

L. “Provide” means furnish and install for a complete, finished, and operable system and ready for intended use.

M. “Shop Drawings” means Document which fully details equipment and intended installation relative to this specific Project.

N. “Structural Members” means all above and below grade elements associated with the structural support of the building or structure.

O. “Substantial Completion” shall mean that the entire project (or readily definable portion thereof if so designated in the Contracted Documents) is acceptable to code enforcement authorities and to extent required by such authorities, has been inspected and approved by such authorities, and is suitable for occupancy by the Owner or occupant for the purpose intended. Refer to Divisions 00 and 01 for additional requirements.

P. “Work” or “Project” means entire scope of work required by the Contract Documents.

Q. Abbreviations:

A/E	Architect
ADS	Acoustical Distinguishable Space
AFCI	Arc Fault Circuit Interrupter
AHJ	Authorities Having Jurisdiction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
ATP	Acceptance Test Procedure
BMS	Building Management System
BOM	Bill-of-Material
C	Degrees Celsius
CEC	Canadian Electrical Code
CCT	Correlated Color Temperature
CIS	Common Intelligibility Scale
CSA	Canadian Standards Association
CR	Controlled Receptacle
CRI	Color Rendering Index
CU	Coefficient of Utilization
DAS	Distributed Antenna System
EBS	Educational Broadband Service
EMS	Energy Management System
EMT	Electrical Metallic Tubing
EPO	Emergency Power Off
ETL	Environmental Technology Laboratory
EUSERC	Electric Utility Service Equipment Requirements
F	Degrees Fahrenheit
FC	Foot-candle
FM	Factory Mutual Engineering Corporation
GB	Ground Fault Circuit Interrupter Breaker
GFCI	Ground Fault Circuit Interrupter
GFI	Ground Fault Circuit Interrupter
GUI	Graphical User Interface
HDPE	High-density polyethylene
HID	High-intensity discharge
HVAC	Heating, Ventilation and Air Conditioning
IC	Insulation contact
IBC	International Building Code
IDF	Intermediate distribution frame
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IMC	Intermediate Metal Conduit
K	Kelvin
kVA	Kilo Volt Amps
LED	Light-emitting diode
LPI	Lightning Protection Institute
MC	Metal Clad
MDF	Main distribution frame

NEC	National Electrical Code, NFPA 70 (latest adopted edition with Amendments)
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Test Laboratory
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PDU	Power Distribution Units
PF	Power factor
RMC	Rigid Metal Conduit
RMS	Root Mean Square
RTRC	Reinforced thermosetting resin conduit
SCCR	Short Circuit Current Rating
SPD	Surge Protective Devices
STC	Factory Standard Test Condition
STI	Sound transmission index
STIPA	STI for public address systems
TCLP	Toxicity characteristic leaching procedure
THD	Total Harmonic Distortion
TIA	Telecommunications Industry Association
UL	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply
V	Volts
VOIP	Voice Over Internet Protocol
VRLA	Valve Regulated Lead Acid Batteries

1.06 MATERIALS

A. Where two or more manufacturers are listed, select for use any of those listed. The first mentioned, in general, was used as the basis of design. Bids on any manufacturer named acceptable as long as that manufacturer meets every aspect of the Contract Documents. Note that equipment layout is based on equipment listed in equipment schedules.

B. Ensure that equipment will fit within available space. Where other than basis of design manufacturer is selected for the Project, the Contractor is responsible for verifying equipment will fit within available space and meet manufacturer’s and code required clearances.

C. Where other than basis of design manufacturer is selected for the Project, include cost of resulting additional work, coordination with other trades, and redesign of associated building services and structure as required to accommodate selected equipment. Include redesign drawings with submitted Shop Drawings.

D. Should any proposed product requires redesign work by A/E to accommodate proposed Product, costs for such redesign work shall be included in the Bid amount. The Owner will compensate Engineer through the A/E at rate of $150.00 per hour for time and expense for required review of submittals and additional coordination for redesign work. Amount of compensation will be deducted from Final Payment to the Contractor.

1.07 STANDARDS OF QUALITY

A. Materials and Equipment: UL listed and labeled or other AHJ approved testing laboratory and in compliance with other industry standards as specified.

B. Equipment shall be manufacture's regularly catalogued items and shall be supplied as a complete unit in accordance with manufacturer's standard specifications and any optional items required for proper installation for equipment unless otherwise noted. Equipment and materials shall be installed in accordance with the manufacturer's recommendations and best trade practices.

C. Products shall be new unless indicated otherwise in the Contract Documents.

D. Fabricator and Manufacturer Qualifications: Specialists with at least 5 years' experience and regularly engaged in manufacture of equipment and materials specified.

E. Furnish products of a single manufacturer for items which are used in quantity. A Product, for the purpose of this paragraph, is an assembly of components such as switchboards, transformers, panelboards, and similar items. Materials such as wire and cable, raceways, outlet boxes, and similar items not requiring maintenance are not included in the single manufacturer requirement of this paragraph.

F. Installer Qualifications: Specialists with at least 5 years' experience and regularly engaged in the installation of the system, equipment, and materials specified. Where required by the AHJ, employ licensed trades persons.

1.08 SUBSTITUTIONS

A. Comply with requirements in Division 01 with additional requirements indicated in this article.

B. Substitutions will be considered following bid award only when a product becomes unavailable through no fault of the Contractor.

C. Where "Manufacturer" paragraphs include the words "or approved", prior approval of the proposed substitution is required. The A/E is sole judge of quality of proposed substitution.

D. When the A/E approves a substitution request, the approval is given with the understanding that the Bidder:
   1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
   2. Will provide the same warranty for the Substitution as for the specified Product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.

E. Whenever a Product is described by detail, specification, trade name, manufacturer's name or catalog reference, use only such Product, unless written approval is given for substitution prior to bid. Submit written requests on substitution request form included in Division 01. Approved substituted manufacturers will be listed by Addendum. There are no prior approvals for this project.

F. Provide as specified certain products, materials, and systems where "manufacturer" paragraphs are followed by the words "no substitutions".

G. Substitutions will not be considered when they are indicated or implied on Shop Drawings or product data submittals, without separate written prior approval, or when approval will require revision to the Contract Documents.

1.09 DRAWINGS AND SPECIFICATIONS

A. General: The electrical drawings are diagrammatic. Complete details of building features which affect electrical installation may not be shown. For additional details, refer to other Contract Documents. Report any discrepancies to the A/E along with suggested revisions. Obtain written response from the A/E before proceeding with changes.

B. Depiction of Work: Drawings do not show the exact characteristics of the work including, physical arrangement of equipment, lengths of wiring or conduit runs. Base work on actual field measurements and conditions. Provide work required to complete the installation.

C. Dimensions: Do not scale drawings. Dimensional accuracy is not guaranteed, and field verification of dimensions, locations, and levels to suit field conditions is required.

D. Since the Drawings of floor, wall, and ceiling installation are made at small scale, outlets, devices, equipment, and similar items are indicated only in their approximate location. Locate outlets and apparatus symmetrically on floors, walls, and ceilings where not dimensioned and coordinate such locations with work of other trades to prevent interferences.

E. Discrepancies: Field verify dimensions and existing conditions prior to performing work. Bring to the A/E's attention any discrepancies within the Contract Documents and between the Contract Documents and field conditions. Also for any design and layout changes required due to specific equipment selection, prior to the Contractor's work (equipment and material purchasing and installation). Any corrective work required by the Contractor after his discovery of such discrepancies, inconsistencies, or ambiguities shall be at no additional cost to the Owner.

F. Specifications: These specifications are written in imperative mood and streamlined form. The imperative language is directed to the Contractor, unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

1.10 RECORD DRAWINGS

A. Comply with requirements in Division 01, with additional requirements as indicated in this article.

B. Prepare As-Built drawings: As-Built Drawings shall be red line prints in digital or hand drawn format (pencil and black pen not acceptable).
   1. Corrections and Changes: Record during the progress of the Work, showing work as actually installed.
      a. Show the measured locations of portions of the Work and changes the Contractor has made.
      b. In general, tolerance plus or minus 1'-0" from actual location.
      c. Show addendum items, change orders, clarifications, supplemental instructions, and deviations from the Drawings. Show device or equipment changes and indicate where the change was originated. Only indicating the document where the change originated from will not be accepted.
   2. Updates: Neatly hand-draft on daily basis and kept readily available at project site. Updates are subject to review by the A/E on a regular basis throughout construction. Updates are to include the following at a minimum:
      a. Feeder routing indicating upstream and downstream equipment.
      b. Installation locations for underground raceways and where they transition to above grade.
      c. Device locations and mounting heights.

d. Junction and pull boxes with two or more home runs.
e. Junction and pull boxes with one home run.
f. Circuit information.
g. Shop Drawings: Update shop drawings with changes or deviations from the Original Shop Drawings. Provide updates to manufacturer/vendor for inclusion in Record Drawings.

C. Record Drawings: Develop a digital set of Record Drawings for the project utilizing the as-built drawings. Digital Record Drawings can be in AutoCAD or PDF format. At end of construction, check drawings for completeness and accuracy.

D. Shop Drawing Record Drawings: Provide updated shop drawings based on As-Built drawings for use as Record Drawings.

E. Per project closeout procedures, submit in Digital Record Drawings and a copy of the As-Builts. Each sheet shall be noted as “RECORD DRAWING”.

1.11 COORDINATION

A. Coordinate Divisions 26, 27, and 28 work with other trades.

B. Be aware of restricted space for installation of electrical systems. Include offsets and perform rerouting and coordination to fit elements in available space. Include provisions for such requirements in bid.

C. Electrical equipment and systems shown are based on existing drawings as available and on limited project site observations to the extent possible under current conditions. Field verify existing conditions prior to commencement of work. Obtain specific locations of structural and architectural features or equipment items from referenced drawings, field measurements, or trade providing material or equipment.

D. Coordinate raceway installations to clear light fixtures and electrical cable trays. Include clearance over light fixtures to allow removal and replacement. Include minimum 6 inch clearance above and to sides of cable trays.

E. Existing Conditions:
1. General Construction:
a. Installation of electrical, telecommunications, and electronic safety and security work will require openings, removal and replacement of ceilings, sleeves, and restoration of general construction to match existing. Some work occurs in areas not requiring alterations as part of architectural work. Coordinate new openings and restoration work so that there is no additional cost to the Owner.
b. General construction work shown on the architectural drawings may require removal, relocation, and reinstallation of existing electrical, telecommunications, electronic safety and security work. Since existing conditions cannot be completely detailed on the Drawings, survey the site and perform required Work at no additional cost to the Owner.
2. This project may require work in the presence of asbestos containing material (ACM). Division 26 does not provide for or cover the identification, removal, incapsulation, or disposal of such material. If the presence of ACM is suspected, notify the Owner prior to proceeding with in the vicinity of ACM.

F. Be responsible for beam penetrations as they relate to the electrical work. Submit sizes and locations to the structural engineer for review and determination of structural details.

G. Coordinate attachments to structure to verify that attachment points on equipment and structure can accept seismic, weight, and other loads imposed.

H. Refer to architectural and structural drawings for location of expansion and seismic joints. Provide flexible loops for raceways and cable trays crossing expansion and seismic joints.

1.12 WORKMANSHIP

A. Work shall be in accordance with best trade practices. Remove substandard workmanship and provide new material at no extra cost to the Owner.

1.13 SITE VISIT

A. The Contractor shall visit site during bidding period to note conditions affecting installation of Work. No additional charges allowed due to failure to adequately review conditions.

B. Investigate each space through which equipment must be moved. Where necessary, arrange with equipment manufacturers to ship equipment in sections with suitable dimensions for moving through restricted spaces. For movement through occupied spaces, ascertain from the Owner as acceptable times of day or night that movement could occur. Include costs in bid for off hours labor, reassembly, and field testing.

1.14 CERTIFICATION

A. By submitting a bid for the electrical, telecommunications, electronic safety and security systems, the Contractor and his subcontractors acknowledge and certify the following:
   1. That they have carefully examined and fully understand the Drawings and Specifications (including but not limited to architectural, site, utility, mechanical, structural and electrical drawings and specifications. In addition, they have determined that the Drawings and Specifications are adequate to complete the electrical systems and that they can provide a complete finished and operable system in accordance with the Contract Documents.
   2. That they have had a reasonable opportunity to discover any ambiguities in the Contract Documents and such ambiguities have been brought to the attention of the A/E in writing prior to submitting the bid.
   3. That they have reviewed the project progress schedule with the general contractor, fully understand the schedule, and they have verified, prior to submitting a bid, availability of necessary labor and materials, including supervision and office backup, and can comply with the schedule requirements.
   4. That there may be changes to the scope of work and that they understand that any proposal submitted for performance of additional work shall include costs associated with such change including but not limited to labor, materials, subcontracts, equipment, taxes, fees, schedule impact, loss of efficiency, supervision, overhead and profit.
   5. That the Contract requires them to coordinate their work with that of other trades and that responsibility for coordination includes rerouting, offsets, and similar provisions, to fit Work and address manufacturer’s recommended clearances for service access, maintenance, and replacement of equipment in a manner that is compatible with work of other trades in the same area.
   6. That routing of elements of electrical systems shown on the Drawings is schematic only and that offsets and rerouting probably will be required in installation and that labor and materials have been included for such in their bids.

7. That they understand submittals of material and equipment to the A/E is for the purpose of establishing what they are providing for the project. Any review undertaken by the A/E does not relieve them of their responsibilities to furnish and install materials and equipment required for work in the project nor does such review relieve them of their responsibilities for coordination with other trades and designers to ensure that such materials and equipment will fit and be suitable for purpose intended.
8. That they agree to receive payment for bid amounts as full compensation for furnishing materials and labor which may be required in prosecution and completion of work required under the Contract Documents, and in respects to complete the contract work to the satisfaction of the A/E.
9. That they include in their bids costs to furnish bonds as specified in the Contract Documents.

1.15 WARRANTY

A. Conform to requirements in General Conditions, Supplementary Conditions, and Division 01. Where not so prescribed or defined, the period shall be 1 year. Warranty periods within Divisions 26, 27, and 28 shall not commence until Substantial Completion. Contractor shall extend longer warranties specified in other sections.

1.16 EQUIPMENT FURNISHED BY OWNER INSTALLED BY CONTRACTOR (FOIC)

A. Material Handling and Delivery: Coordinate delivery of FOIC equipment. Receive, off load, transport, store, hoist, unpack, dispose of packing, same as for other project equipment arriving at job site. Requirements of the Contract Documents apply to FOIC equipment.

B. Operation and Maintenance Data: Obtain from the Owner operation and maintenance data for the FOIC equipment and incorporate them into the Operations and Maintenance Manuals.

C. Start-up and Warranty:
   1. FOIC equipment suppliers will pass on to the Contractor start-up information, maintenance and parts information, and warranty provisions of their products in accordance with the equipment suppliers contract requirements. Organize and coordinate start-up and warranty requirements for the FOIC equipment.
   2. Include one year warranty on FOIC equipment starting at Substantial Completion regardless of shorter time limits by FOIC suppliers.

1.17 DEMONSTRATION

A. Comply with requirements in Division 01 with additional requirements indicated in this article.

B. Following installation of electrical work and prior to final acceptance, demonstrate that equipment and systems operate as indicated in the Contract Documents and in accordance with manufacturer’s recommendations.

C. Perform in presence of the A/E and Owner’s representative, unless otherwise directed by the A/E. Give minimum 1 week notice prior to demonstrations.

D. Provide instruments and personnel required to conduct demonstrations.

1.18 SUBSTANTIAL COMPLETION

A. Comply with requirements in Division 01.

B. Prepare list of items that are not complete prior to asking for a substantial completion review by the A/E.

1.19 ALTERNATES

A. General: See Bid Form and Alternates described in Division 01 for possible effect on work of Divisions 26, 27, and 28.

1.20 CONTINUITY OF EXISTING UTILITY SERVICES

A. Shutdown Duration: Comply with requirements in Division 01. Perform work without shutdown of more than 4 hour duration of existing systems. Schedule each shutdown in writing with the Owner at least 7 days in advance of shutdown and obtain advance written approval from the Owner.

B. Temporary Services: Provide during necessary interruptions of existing utilities.

C. Owner Occupancy:
   1. Perform work in the existing building with respect for the necessity of the Owner's employees to perform their regular work.
   2. Plan installation of new work and connections to existing work to assure minimum interference with regular operation of existing facilities. Do not remove, disconnect, or shutdown systems without prior review by the Owner to confirm that areas needed to remain in operation are not affected.
   3. Provide temporary, wiring, lighting, and similar systems and connect to existing systems to keep existing electrical systems in operation to service areas that need to remain occupied.

1.21 OPERATION AND MAINTENANCE MANUALS

A. Prepare Operation and Maintenance Manuals for equipment and materials furnished under Divisions 26, 27, and 28.

B. Comply with requirements in Division 01 with additional requirements indicated in this article.

C. Submit one hard copy and one electronic PDF format of Operation and Maintenance Manuals for review at least 4 weeks prior to Substantial Completion date. Assemble hard copy Operation and Maintenance Manual in 3-ring binder(s). Use multiple binders if pages in a single binder would exceed 4 inch thickness. Separate binders for each category, such as Electrical, Telecommunications, and Electronic Safety and Security. Where one subject matter encompasses more than one binder, differentiate by volume numbers. Include indexed tabs for each binder. Engrave cover with the project title in 1/2 inch high letters and name and address of the Contractor in 1/4 inch high letters. Provide same information in 1/8 inch high letters on spine.

D. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Include serial numbers of each piece of equipment, complete lists of replacement parts, motor ratings, and similar information. Each item of equipment shall have its own individual sheet. (Example: If 2 items of equipment A and D appear on the same sheet, individual sheet shall be included for each unit specified.)

E. Include the Following Information:
   1. Identifying name and mark number.
   2. Certified outline drawings and Shop Drawings.
   3. Parts list.
   4. Performance curves and data.
   5. Wiring diagrams.
   6. Manufacturer's recommended operating and maintenance instructions.

7. Vendor's name, address and telephone number for all parts and equipment.
8. Name, address and telephone number of Contractor performing the work.
9. Test reports.
10. Product data and Record Drawings.

1.22 TESTING

A. Comply with requirements in Section 260810.

1.23 PROJECT TRAINING

A. Upon completion and testing of equipment and system installation, assemble equipment factory representatives and subcontractors for system training with Owner's representatives as required in specific specification sections.

B. Each representative and subcontractor shall assist in start-up, check out, and training for their respective system and remain on-site until the total system operation is thoroughly reviewed by the Owner's representatives and are thoroughly trained. Return for additional training sessions as required to completely train Owner's Representatives.

C. Factory representative and system subcontractor shall give personal instruction on operating and maintenance of their equipment to the Owner's maintenance and operation personnel. To certify acceptance of operation and instruction by the Owner's representative, prepare a written statement as follows:
   1. This is to certify that the factory representative and system subcontractor for each system listed below have performed start-up and final check out of their respective systems.
   2. The Owner's maintenance and operation personnel have received complete and thorough instruction in the operation and maintenance of each system.

SYSTEM	FACTORY REPRESENTATIVE
(List systems included)	(List name and address of factory representative.)
Owner's Representative	Contractor

D. Submit copy of acceptance to A/E.

1.24 PUNCHLIST AND FINAL REVIEWS

A. At the time of punchlist and final reviews, the project electrical foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested to allow review of entire electrical system.

B. Punch List: Review each punch list item; update field conditions to address items or provide comment response for reason the item has not been addressed in the field.

1.25 PROJECT CLOSEOUT

A. Engineering services required beyond the final completion date shall be paid by the Contractor at a rate of $150 per hour.

B. Punchlists will be done at Substantial Completion and final completion dates. Submit Record Drawings and final Operation and Maintenance Manuals prior to Substantial Completion date. Subsequent reviews shall be paid by the Contractor at a rate of $125 per hour.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes basic electrical requirements specifically applicable to Divisions 26, 27, and 28 sections including general material and installation requirements and site work.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. UL Compliance: Where UL fire-resistance rating is indicated for construction penetrated by access units, furnish UL listed and labeled units, except for those units which are smaller than minimum size requiring ratings as recognized by governing authority.

C. Codes and Standards:

1. ASTM D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods to prevent damage, deterioration, and loss, including theft.

B. Deliver products to site in manufacturer's original containers, complete with labels.

C. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

D. Store products subject to damage by weather conditions above ground, under cover in weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

A. Furnish specified items acceptable to AHJ as suitable for intended use.

B. New, unless otherwise indicated, free from defects and the standard products of reputable manufacturers regularly engaged in production of such equipment.

C. Furnish similar items of equipment by same manufacturer.

D. Materials and Equipment: UL listed and labeled or other AHJ approved testing laboratory and in compliance with other industry standards as specified.

E. Remove rejected or damaged material from site.

F. Samples may be required for non-standard or substituted items before installation. Submit samples as required in specific specification sections.

G. Furnish required items necessary for installation and testing procedures.

2.02 POSTED INSTRUCTIONS

A. Posted Operating Instructions: Furnish simplified, consolidated equipment control and power diagrams. Graphically represent entire system and actual equipment installed. Include concise written instructions on how to start and stop systems. Show settings and conditions to be observed. Indicate what control adjustments are to be made or maintained by the operator.
   1. Include control diagrams and specific operating instructions.
   2. Indicate how to energize each major component of systems. Show what action must be taken in an emergency, how to restore power following an outage, and what precautions to be taken when maintenance is required.
   3. Include photographic or comparable non-fading reproductions, either framed under glass or encased in non-discoloring plastic.
   4. Include one-line diagrams of electric power distribution riser.

B. Copies of operating instructions shall be used with Operation and Maintenance Manuals as basis in training Owner's employees in the operation and maintenance of systems and related installed equipment.

2.03 ENCLOSURES

A. NEMA Type 1 – Dry Interior locations unless otherwise noted on drawings or as specified below.

B. NEMA 3R Weather-proof/Rain-proof – Windblown rain, sleet, ice – Provide in all locations where exposed to moisture unless otherwise noted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify installation conditions as satisfactory to receive work of the various sections. Do not install until unsatisfactory conditions are corrected.

3.02 INSPECTIONS

A. Confirm that installations have been inspected before enclosure within building features, buried, or otherwise hidden from view. Pay costs associated with uncovering or exposing installations and features not previously inspected and for repair to exposed surfaces.

3.03 PREPARATION

A. Protect surrounding areas and surfaces to prevent damage as work is installed.

B. Obtain equipment roughing-in dimensions from approved Shop Drawings or actual measurements.

C. Be familiar with the location of other trade's equipment. Eliminate conflicts. Check door swings before installing switches. Locate switches on strike side of doors unless noted otherwise.

D. Layout electrical, telecommunications, and electronic safety and security work in advance of construction to eliminate unnecessary cutting, drilling, channeling, and similar activities. Where such cutting, drilling, channeling and similar activities become necessary for proper installation, perform with care using skilled mechanics of trades involved. Repair damage to building and equipment at no additional cost to the Owner.

E. Perform cutting work of other trades only with consent of that trade. Cutting structural members not permitted without consent of the A/E.

3.04 INSTALLATION

A. Install Work as specified and in accordance with the Drawings and manufacturer's instructions. Where these conflict, manufacturer's instructions govern.

B. Review Architectural, Mechanical and other applicable drawings and applicable Shop Drawings to prevent switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, and similar items, or from being located in whiteboards, tackboards, glass panels, and similar items. Relocate electrical devices and connections as directed by the A/E at no additional cost to the Owner if the work is not properly coordinated.

C. Where conduit, outlets, and apparatus are encased in concrete, locate and secure at point of installation. Check locations of electrical items before and after concrete and masonry installation and relocate displaced items.

D. Provide block-outs, sleeves, demolition work, and similar items required for installation of Work specified in this division.

3.05 WORKMANSHIP

A. Work and materials will be subject to observation at any time by the Owner and the A/E.

B. Install material and equipment in accordance with manufacturer's instructions. Provide calibrated torque wrenches and screwdrivers as required.

C. Cutting and Patching: Do not weld to, cut, or notch structural members or building surfaces without approval of the A/E. Restore surfaces neatly to original condition after cutting, channeling, chasing, and drilling of walls, partitions, ceilings, paving, and anchorage of conduit, raceways, and other electrical equipment.

3.06 WELDING, CUTTING, AND DRILLING

A. Perform in accordance with American Welding Society Standards.

3.07 CLEANING

A. Clean equipment, conduit, and fittings and remove packing cartons and other debris created by Divisions 26, 27, and 28 Work.

B. Before Substantial Completion, carefully clean equipment, fixtures, exposed raceways and similar items. Remove construction labels, dirt, cuttings, paint, plaster, mortar, concrete, and similar items. Clean fixtures, interiors and exteriors of equipment and raceways.

3.08 IDENTIFICATION

A. Provide nameplates and decals required to identify equipment and components, comply with requirements in Section 260553.

B. Mount operating instructions and diagrams near equipment or elsewhere as otherwise designated by the Owner.

3.09 PROTECTION

A. Protect equipment during and after electrical hookup, painting, and final testing.

3.10 REMOVAL AND REPLACEMENT OF EXISTING ACCESSIBLE CEILING PANELS

A. General: Remove and reinstall necessary panels in existing accessible ceilings to install electrical work in areas where no architectural work is being performed. Where existing ceiling panels are damaged, replace with new to match existing. After ceiling removal and reinstallation is complete, ceiling system appearance shall match adjacent similar ceilings that have not been removed.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes final electrical connection to equipment having electrical requirements. Contractor shall make final connections for Owner furnished equipment including switches, receptacles, and similar items. See other applicable specification sections for building temperature control wiring requirements specified in Divisions 21, 22, and 23.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

C. Connection to Equipment Specified in Divisions 21, 22, and 23 as Follows unless Specified Otherwise in Divisions 21, 22, and 23:

1. For motorized only equipment with built-in controllers (packaged equipment), Connect power and provide an external disconnect at equipment. Division 23 will provide control wiring.
2. For motorized only equipment with external controller (non-packaged equipment), provide external motor controller, disconnect switch, and make power wiring complete to equipment. Division 23 will provide control wiring.
3. For electric duct heaters with built-in controllers (packaged type equipment), connect power complete and provide external disconnect switch at equipment. Division 23 will provide control wiring.
4. For electric duct heaters with remote controllers (non-packaged type equipment), provide external controller, disconnect switch, and make power wiring to equipment. Division 23 will provide control wiring.
5. For combination motorized and electric heating packaged units specified with built in controllers and specified with “single point electrical connection” under Division 23, connect power and provide external disconnect switch. Division 23 will provide control wiring.
6. For equipment requiring a full voltage non-reversing starter, include as a combination disconnect unit.

D. Refer to Division 23 sections for control system wiring.

E. Refer to sections of other divisions for specific individual equipment power requirements.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. NEC Compliance: Comply with applicable portions of NEC as to type of products used and installation of electrical power connections.

C. Comply with applicable NEMA standards and refer to NEMA standards for definitions of terminology herein. Comply with NEC for workmanship and installation requirements and to applicable Division 26 sections.

D. UL Labels: Provide electrical connection products and materials which have been UL listed and labeled.

PART 2 PRODUCTS

2.01 ELECTRICAL CONNECTIONS MATERIALS

A. For each electrical connection indicated, include complete assembly of materials, including but not limited to, raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories to complete splices, terminations, and connections.

B. Comply with requirements in Section 260519 for wires and cables, Section 260533 for raceway systems, and Section 262726 for wiring devices.

C. Include Final Connections for Equipment Consistent with the Following:
   1. Permanently Installed Fixed Equipment: Flexible seal-tite conduit from branch circuit terminal equipment, and raceway to equipment, control cabinet, terminal junction box, and wiring terminals. Totally enclose wiring in raceway.
   2. Movable and/or Portable Equipment: Wiring device, cord cap, and multi-conductor cord suitable for equipment and in accordance with NEC requirements.
   3. Other methods as required by NEC and as required by special equipment and field conditions.

PART 3 EXECUTION

3.01 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.

C. Coordinate installation of electrical connections for equipment with installed equipment.

D. Verify electrical loads (voltage, phase, full load amperes, number and point of connections, minimum circuit ampacity, and similar characteristics) for equipment furnished under other divisions, by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment electrical characteristics. Report variances from electrical characteristics noted on electrical drawings to the A/E before proceeding with rough-work.

E. Obtain and review equipment submittals and shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.

F. Comply with requirements in Section 260553 for identification of electrical power supply conductor terminations.

3.02 STARTERS (CONTROLLERS)

A. Install non-packaged starters and wiring devices near motors or as indicated on the Drawings. Securely support and anchor in accordance with manufacturer’s installation instructions. Locate for proper operational access, including visibility for safety.

3.03 PROVISIONS FOR MECHANICAL CONTROLS

A. Provide 120 Volt, 20 Amp circuit at locations required and described in Section 230900. Coordinate exact locations prior to installation.

B. Install power metering equipment at panelboards and switchboards furnished by control system subcontractor at locations required and described in Section 230900.

3.04 EQUIPMENT SHORT CIRCUIT CURRENT RATING

A. All mechanical equipment, packaged systems, control panels, motor starters, motor controllers, variable frequency drives and similar equipment shall carry a Short Circuit Current Rating (SCCR) equal to or greater than the available fault current delivered from the electrical system. Coordinate final available fault currents with the contractors providing this equipment.

3.05 MECHANICAL – ELECTRICAL INTERFACE SCHEDULE

A. Establishing the separation of work between trades and subcontractors is not within scope of these Contract Documents. The following schedule is proposed for assistance in bidding only.

B. Unless otherwise indicated in the Contract Documents, mechanical equipment and controls are suggested to be furnished, installed, and wired in accordance with the following schedule. Coordinate work with Division 22 and 23 sections.

Item	Furnished By:	Installed By:	Power Wiring By:	Control Wiring By:
1. Equipment Motors:	M	M	E	M
2. Magnetic Motor Starters and Equipment Connections:				
a. Automatically Controlled with or without HOA Switches:	E	E	E	M
b. Manually Controlled:	E	E	E	E
c. Furnished with Mechanical Equipment, Factory Mounted:	M	M	E	M
d. Furnished with Mechanical Equipment, Field Mounted:	M	E	E	M
3. Disconnect Switches and 120 Volt Receptacles per IMC and NEC:	E	E	E	--
4. Manual Motor Starters, Thermal Overload Switches:	E	E	E	--
5. Combination Fire/Smoke Dampers, Smoke Dampers:	M	M	E	E
6. Section 230900 Automatic Temperature Controls: Valve and Damper Actuators, Low Voltage Electric Thermostats, Switches, other Miscellaneous Controls:	M	M	M	M
7. Electric Radiant Heating Panels, Baseboard Heaters, Cabinet Heaters, Unit Heaters:	M	M	E	M
8. Electric Duct Heating Coils:	M	M	E	M
9a. Duct Smoke Detectors:	E	M	E	E
9b. Relays and Ancillary Devices Associated with HVAC Unit Shutdown by Duct Smoke Detectors:	E	E	E	E
10. Electric Heat Trace:	M	M	E	M
11. Variable Frequency Drives:	M	M	E	M

Item	Furnished By:	Installed By:	Power Wiring By:	Control Wiring By:
12. Section 230900 Control Panels:	M	M	E	M

M = Division 22 and 23, Plumbing and HVAC
E = Division 26, Electrical

For purposes of the above table, responsibility of power and control wiring includes raceways, connections and other components as required for complete installation of wiring system.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes selective demolition of existing electrical work as indicated in the Contract Documents.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

A. Dust Control: Provide protective measures to minimize transfer of noise, dust, dirt, and refuse to adjacent areas of building. Such measure may include dusttight barriers, temporary walls, portable exhaust fans, vacuum systems, and temporary partitioning.

B. Extent: Keep areas of demolition as clean and orderly as physically possible. Do not allow demolition debris to accumulate. Gather debris and dispose daily. Broom or vacuum-clean work areas on daily basis.

C. Protection: Protect existing equipment, furnishing, and systems with protective coverings. Protect finished surfaces including floors, ceilings, and walls.

3.02 DAMAGES

A. Repairs: Promptly repair damage to existing surfaces, equipment, finishes, or adjacent facilities at no cost to the Owner and to the satisfaction of the A/E and the Owner.

3.03 DEMOLITION

A. General: Provide demolition work required in existing building for removal of existing electrical equipment, raceways, and conductors and for installation of new electrical equipment, raceways, and conductors. Relocate and modify existing electrical equipment, raceways and conductors as required by general construction alterations and by installation of new electrical equipment, raceways, and conductors in existing building to achieve a complete and functioning installation as defined in the Contract Documents.

B. Extent: Remove and dispose of existing materials indicated in the Contract Documents to be removed.

C. Reuse: Do not reuse existing products unless indicated on the Drawings.

D. Materials to Owner: Deliver items to the Owner’s Representative as indicated in the Contract Documents.

E. Materials to Contractor: Materials other than those reserved by the Owner.

F. Existing Conditions: Comply with requirements in Division 01. Verify specific demolition work and operating conditions to be encountered from on-site review and coordination with the Owner. Maintain service to existing equipment and devices during new construction work as required by construction sequencing/scheduling provisions. In areas adjacent to new construction work, provide temporary services as necessary to meet these conditions. Protect active conductors encountered. Notify the A/E of utilities encountered whose services are not known.

G. Repair of Damages to Underground Utilities: Exact location of existing underground utilities is not definitely known. Should any underground utilities be damaged in excavations, restore such utilities without additional cost to the Owner.

H. Drilling of Concrete: Drill openings through existing concrete with diamond tipped rotary core-drilling equipment or carbide tipped drills. In existing post tensioned slabs, locate and mark post tensioned strand locations with subsurface interface radar type locating equipment prior to drilling, cutting, and sawing operations.

I. Saw-Cutting of Concrete: Saw cut through existing concrete with diamond tipped or carbide tipped saw blade. In existing post tensioned slabs, locate and mark post tensioned strand locations with subsurface interface radar type locating equipment prior to drilling, cutting, and sawing operations.

3.04 DISPOSAL OF DEMOLISHED MATERIALS

A. Disposal: Remove debris, rubbish, and other materials resulting from demolition operations from building site unless reinstalled or delivered to the Owner as indicated in the Contract Documents. Transport and legally dispose of material off site.

B. Burning: Burning of removed materials is not permitted on project site.

3.05 CLEAN-UP AND REPAIR

A. Clean-Up: Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protection and leave interior areas clean.

B. Repair: Repair demolition performed in excess of that required at no additional cost to Owner. Return structures and surfaces to conditions existing prior to commencement of demolition work or as directed by the Owner.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes wire, cable, splices, and terminations for systems 600 Volts and less and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. NFPA 70, National Electrical Code (NEC).
   2. UL 83, Thermoplastic-Insulated Wires and Cables.
   3. UL 62275, Cable Ties for Electrical Installations

C. Comply with NEC as applicable to construction and installation of electrical wire and cable. Electrical wire and cable UL listed and labeled.

D. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of wire and cable.

E. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of wire and cable.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data for each type of wire, cable, and appurtenance.

C. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 PRODUCTS

2.01 POWER AND LIGHTING CIRCUITS

A. Factory-fabricated conductors of sizes, ratings, materials and types indicated on the Drawings for each service. Where not indicated, select to comply with project's installation requirements and NEC standards. Comply with the following:
   1. UL 83.
   2. Copper Conductor - Stranded.
   3. Insulation type THHN/THWN-2 dual rated, 600 Volt for circuits from 115 to 600 Volts.
   4. Use only 90 C insulated conductors based on 75 C ampacity tables of the NEC.

2.02 CONTROL AND SIGNAL CIRCUITS

A. Class 1:
   1. UL 83.
   2. Stranded copper conductor.
   3. Insulation type THHN, or THWN, 600 Volt for circuits from 115 to 600 Volts.

B. Class 2 and 3:
   1. Copper conductor, 300 Volt insulation, rated 75 C in dry locations and 60 C in wet locations. Individual conductors twisted together and covered with non-metallic jacket unless otherwise noted on the Drawings.
   2. UL listed for use in air handling ducts and hollow spaces used as ducts and plenums.
   3. Category UTP cabling for electrical control systems:
      a. Cable type per system manufacturer and shop drawings.
      b. Cables shall meet the most current technical characteristics of TIA-568-C standard.
      c. Cables shall be NFPA 262 CMP (plenum) rated, unless otherwise noted.

2.03 PLASTIC CABLE TIES

A. Teflon or nylon, locking type

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.04 WIRING AND CABLE INSTALLATION, GENERAL

A. Install electric conductors and cables as indicated on the Contract Drawings, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standards of Installation," and in accordance with recognized industry practices.

B. Coordinate installation work with electrical raceway and equipment installation work for proper interface.

C. Pull cables by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device made through approved swivel connection. Non-metallic jacketed cables of small size may be pulled directly by conductors by forming them into a loop to which pull wire can be attached. Remove insulation from conductors before forming loop. Larger sizes of cable may be pulled by using basket weave pulling grip, if pulling force does not exceed limits recommended by manufacturer. If pulling more than one cable, bind them together with friction tape before applying grip. For long pulls requiring heavy pulling force, use pulling eyes attached to conductors.

D. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In all cases, pulling tension applied to conductors limited to 0.008 lbs. per circular mil of conductor cross-section area.

E. Pull in cable from end having the sharpest bend (bend closest to reel). Keep pulling tension to minimum by liberal use of lubricant, turning of reel, and slack feeding of cable into duct entrance. Employ not less than one person at reel and one in vault during this operation.

F. For training of cables: provide 12 times cable diameter minimum bend radius to inner surface of cable.

G. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50 percent greater than specified above for training.

H. Apply wire and cable pulling compound recommended by specific cable manufacturer.

I. Seal cable ends unless splicing is done immediately.

J. Support cables in vaults, concrete trenches, and similar locations by cable racks. Secure to rack insulators with nylon cord or self-locking nylon cable ties. Place each cable on separate insulator.

K. Follow manufacturer's instructions for splicing and cable terminations.

L. Provide separate neutral conductor for each circuit serving single phase loads, unless indicated otherwise on the Contract Drawings. Where shared neutrals are indicated for multi-wire branch circuits, provide circuit breaker handle ties per Section 262813.

M. Branch circuit wiring shall be grouped in separate raceways as indicated on the Contract Drawings. Where branch circuit raceways are not indicated on Contract Drawings, a maximum of three circuits may be installed in the same raceway if each circuit originates from the same panelboard.

3.05 WIRING METHODS, GENERAL

A. Install wiring in raceways unless indicated otherwise on the Contract Drawings or authorized by the A/E.

B. Install Wire After:
   1. Interior of building is protected from weather.
   2. Mechanical work likely to injure conductors is completed.
   3. Conduits have been cleaned and moisture removed.

C. Neatly train and lace wiring inside boxes, equipment, and panel boards.

D. Clean raceway system before installing conductors.

E. Use half-lapped synthetic tape if taping is utilized for insulation purposes.

F. Provide conductor support devices as required by NEC in vertical conduit runs.

G. Torque conductor connections and terminations to manufacturer's recommended values.

H. Maintain minimum 12-inch clearance between open cabling and heat sources such as flues, steam pipes, and heating appliances.

3.06 MINIMUM SIZES

A. Minimum No. 12 AWG for power and lighting circuits.

B. Minimum No. 14 AWG for control wiring.

C. Power and lighting circuits with home run lengths greater than 100 feet. No. 10 AWG minimum.

D. Power and lighting circuits with home run lengths greater than 150 feet. No. 8 AWG minimum

3.07 CLASS 2 AND 3 CABLE INSTALLATION

A. Class 2 and 3 Cable: Install in conduit.

3.08 WIRING SPLICES AND TERMINATIONS

A. Splice only in accessible junction boxes.

B. Splices and Taps:
   1. Use compression-set pressure connectors with insulating covers or screw-on pressure (wire nuts) for sizes No. 10 AWG and smaller.
   2. Use compression-set pressure connectors with insulating covers for wire splices and taps sizes No. 8 AWG and larger. Split bolt splices and connectors not acceptable.

C. Terminations: Eye-type compression lug when termination is to a bolt or screw terminal.
   1. 250 kcmil and larger, two-hole long barrel compression lugs.
   2. Smaller than 250 kcmil: Single hole compression lug.

D. Tape un-insulated portions of conductor and connectors with electrical tape to 150 percent of conductor insulation value.

E. Clean wires before installing lugs and connectors.

F. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.

G. Leave minimum 8 inches of pigtail at outlet boxes for connection to fixtures and devices. Where wiring is continued to other outlets, splice connection wire in a tap. In no case will continuity through double terminal of device be allowed for either hot or neutral leg of circuit.

H. Insulate ends of spare conductors with electrical tape or wire nut.

I. Terminate control circuit conductors at terminal blocks only.

J. Utilize eye or forked tongue type compression set terminator for conductors No. 12 AWG and smaller when termination is to a bolted or screw set type terminal block or terminal cabinet.

K. Make below grade splices in handholes and vaults watertight with epoxy resin type splicing kits similar to Scotchcast.

3.09 FIELD QUALITY CONTROL

A. Test for Wires and Cables in accordance with Section 260810.

B. Test Category 5e UTP cabling as follows:
   1. Horizontal cabling shall be certified to meet or exceed the permanent link performance specifications for Category 5e horizontal cabling tested with a frequency range from 1MHz to 100 MHZ as defined in TIA-568-C.
   2. Certifications shall include the following parameters for each pair of each cable installed:
      a. Building System
      b. Cable identification between system devices
      c. Date of test
      d. Test equipment manufacturer and model number
      e. Wire map
         1) Continuity to the remote end.
         2) Shorts between any two or more conductors
         3) Reversed pairs
         4) Split pairs
         5) Transposed pairs
         6) Any other miswiring
      f. Length
      g. Near-end crosstalk (NEXT)
      h. Power sum-near-end crosstalk (PS-NEXT)
      i. Return loss (RL)
      j. Propagation delay (PD)
      k. Delay skew (DS)
   3. Horizontal cabling shall be tested using a Permanent Link configuration as defined in TIA-568-C.
   4. Test reports with an asterisk (*) or fails, shall be documented identifying the reason for the test failure and a corrective action plan developed.
   5. After corrective action has been completed, the permanent link shall be retested.
   6. Ensure 100 percent of the horizontal cabling system links pass all tests.

C. Test results shall be organized by building system type and cable identification number. The test results shall contain the date and time of when each test was saved in the memory of the tester. The test results shall be recorded in both PDF and manufacturer software formats and provided in the O&M manuals.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes grounding and bonding systems, equipment, and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. IEEE C2, National Electrical Safety Code (NESC).
   2. IEEE 81, Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System Part 2: Normal Measurements.
   3. IEEE 837, Standard for Qualifying Permanent Connections Used in Substation Grounding
   4. NFPA 70, National Electrical Code (NEC).
   5. NFPA 780, Standard for the Installation of Lightning Protection Systems
   6. UL 467, Standard for Grounding and Bonding Equipment.
   7. UL486A-486B, Wire Connectors
   8. ANSI C119.4, Electric connectors - connectors to use between Aluminum-to-aluminum or aluminum-to-copper conductors

C. Comply with NEC and IEEE requirements as applicable to electrical grounding and ground fault protection systems.

D. Products UL listed and labeled.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer’s technical product data for each item and appurtenance.

C. Shop Drawings: Plans showing dimensioned location of grounding system features, including ground rods, ground rings, test wells, grounding electrode system connections, and routing of grounding electrode conductors.

D. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 GROUNDING ELECTRODES AND CONDUCTORS

A. Bare Ground Conductors: Soft drawn copper. Stranded unless indicated otherwise. Tinned where indicated. Solid for No. 8AWG and smaller. Stranded conductors for No. 6 AWG and larger.

B. Insulated Ground Conductors: Copper with 600 Volt insulation in accordance with Section 260519.

2.03 GROUND CONNECTORS

A. Listed and labeled for applications and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connections: Exothermic-welding kits of type recommended by kit manufacturer for materials being joined and installation conditions. Manufacturer: Cadweld, Thermoweld, Thomas & Betts, or approved.

C. Compression Ground Connectors: Conform to IEEE 837 and UL 467.
   1. Cable-to-Cable Connections: Copper or copper alloy. Approved for direct burial or in concrete applications. Manufacturer: Thomas & Betts EZ-Ground® or approved.
   2. Cable-to-Busbar Connections: Two-hole long barrel compression lug, unless indicated otherwise on Contract Drawings.
   3. Cable-to-Cable Tray Connections: Two-hole long barrel compression lug.

D. Mechanical Ground Connectors: Conform to IEEE 837 and UL 467.
   1. Cable-to-Water Piping Connections: Two-piece silicon bronze with stainless steel bolts. Listed for direct bury.
   2. Split-Bolt Connectors: Not acceptable.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

C. Preparation of Surfaces: Clean contacting surfaces of ground connections to bright metal before connecting.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. System ground not to exceed maximum 5 ohms meggered resistance.

C. Ground each separately-derived system neutral to nearest building steel.

D. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, underground metal water piping systems, and gas piping systems.

3.04 GROUNDING ELECTRODE AND CONDUCTOR INSTALLATION

A. Equipment Ground Conductor: Install separate, insulated equipment ground conductor in each feeder and branch circuit. Terminate each end on grounding lug, bus, and bushing and to intermediate metallic enclosures.

B. Isolated Ground Conductor: For isolated ground branch circuits and feeders, install insulated isolated ground conductor. Isolated ground conductor is in addition to equipment ground conductor. Terminate each end on isolated ground bus.

C. Connect grounding conductors to motors in accordance with NEC. Remove paint, dirt, and other surface coverings at grounding conductor connection points so that good metal-to-metal contact is made.

D. Bare Grounding Conductors Below Grade:
   1. Minimum 30 inches below grade.
   2. Not in contact with gravel fill or concrete. Provide Schedule 40 PVC sleeve where routing through concrete.
   3. Train neatly around foundations and footings.

E. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4/0 AWG. Bond to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

F. Size main grounding system per NEC. Provide conduit to protect ground wire from damage to an area 6 feet above floor.

G. Conductor to Conductors, Conductor to Steel, and Conductor to Ground Rod: Exothermic-welded type connectors. Cadweld, Thermoweld, Thomas & Betts, or approved.

H. When making bolted connection to aluminum and galvanized structures, apply corrosion-inhibitor to contact surfaces between cable, connector, and surface of structure. Penetrox A or approved.

I. Ground Bars: Install where indicated on Contract Drawings. Install horizontally at 12 inches above finished floor, unless indicated otherwise.

3.05 GROUND CONNECTORS

A. Welded Connections:
   1. Provide for underground connections.
   2. Provide for connections to structural steel.
   3. Provide for connections to ground bars where indicated.
   4. Provide full weld between coupling and ground rod at joint.

5. Connect grounding conductors to ground rods at upper end of rod with end of rod and connection point below finished grade, except provide bolted connections at test wells and as otherwise indicated.
6. When making connections, wire brush or file point of contact to bare metal surface. Use welding cartridges and molds in accordance with manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and clean joint. Use connectors of specified size for conductors and ground rods. Notify A/E before backfilling ground connections.

B. Ground shields of shielded power and control cable at each splice and termination as recommended by manufacturer.

C. Ground metal sheathing and exposed vertical metal structural elements of building. Ground metal fences enclosing electrical equipment. Bond metal equipment platforms which support electrical equipment to equipment ground. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets, raceways, and similar items carrying circuits to these devices.

3.06 FIELD QUALITY CONTROL

A. Comply with requirements in Section 260810.

B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

C. Include field test reports of grounding system in the Operation and Maintenance Manual.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes conduit and equipment supports, fastening hardware, and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data, rated capacities and accessories for each item and appurtenance.

PART 2 PRODUCTS

2.01 MATERIAL

A. General: Built-up framing for electrical raceway and equipment supporting systems, including but not limited to channel, rod, clamps, and hardware. Comply with requirements in Section 260548 for seismic restraints. Unless design is shown on the Drawings, size for 400 percent of calculated load.

B. Channel: 12 gauge galvanized formed metal with or without pre-drilled holes, Pre-galvanized. Cooper B-Line, Unistrut, Powerstrut, or approved.

C. Beam Clamps, in Pairs, at each Supporting (Structural) Beam: B-line B441-22 and B441-22A; Superstrut U-501 and U-502; Unistrut P2785, P2786, and P1379S, or approved. Submit other manufacturers for approval with evidence proving clamp complies with IBC and ASCE 7-05 for seismic requirements. Submitted proof can consist of letter signed and stamped by a professional engineer licensed in engineering in the state in which the Work is performed.

D. Beam Clamps for Use with Rods: B-Line B751-J4, B751-J6, B751-J9, and B751-J12; Superstrut U-569; Unistrut P2824-6, P2824-9, and P2824-12, or approved. Submit other manufacturers for approval with evidence proving clamp complies with seismic requirements. Submitted proof can consist of letter signed and stamped by a professional engineer licensed in engineering in the state in which the Work is performed.

E. Fittings for Attaching Channel-to-Channel for Built-Up Framing: Unistrut P6028, P6033, P6069, P6290, P6291, P6326, P6331, P6332, P6346, P6358A, P6359, P6381, P6382, P6726A, P6917, P6962, or approved.

F. Connectors for Bracing: Unistrut P6186, P7097, P7098, P7100, P7101, P7108, P7109, P7110, P6546, or approved.

G. Hardware, including Nuts (Locking Type), Bolts, and Set Screws: Corrosion resistant, designed for intended use.

H. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

I. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

J. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58

K. Hanger Rods: Threaded steel

L. Spring Steel Conduit Clips: Erico K series or approved.

M. Circular Cable Retainer:
   1. Cable retainers shall be of plastic material with rounded edges, plenum rated, utilizing an easy-lock closure and an attachment base. Cable retainers shall be screwed into structure and only be utilized in spaces that are extremely tight and J-hooks do not have sufficient space to be mounted.
      a. Manufacturer: Erico Caddy, Part No. CAT CR50

N. Outlet Box Support:
   1. Where more than one outlet box is shown on the Contract Drawings, and indicated to be at same elevation, align them exactly on center lines horizontally with wall mounting bracket.
      a. Manufacturer: Cooper B-Line Series BB8 or approved:

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.04 SUPPORTING DEVICES INSTALLATION

A. Comply with requirements in Section 260548 for seismic restraints.

1. Install diagonal bracing for trapeze support systems at 2 right angle planes to brace against:
   a. Horizontal and torsional movement lateral seismic forces.
   b. Vertical (uplift) movement caused by vertical seismic forces.
   c. Horizontal distortions in conduit system caused by wire pulling.

B. Unless otherwise shown on the Contract Drawings, attach connectors to vertical framing members with 2 bolts

C. Install toggle bolts or hollow wall fasteners in hollow masonry, plaster, and gypsum board partitions and walls. Install expansion anchors or preset inserts in solid masonry walls, self-drilling anchors, and expansion anchors on concrete surfaces. Comply with requirements in Section 260548 for seismic anchors.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
      a. To Existing Concrete: Expansion anchor fasteners.
      b. To Steel: Beam clamps MSS SP-58, Type 19 or 23, complying with MSS SP-69.
      c. To Light Steel: Sheet metal screws.
   4. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements

E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under nuts.

F. Lighting Fixture Supports: Fixture support wires for recessed ceilings, match ceiling support requirements. All fixture supports to comply with requirements in Section 265100 and Section 260548.

G. Raceways:
   1. Single raceway runs: Spacing to comply with requirements of Section 260533
      a. Suspended: support by threaded rod with spring steel conduit clips. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings
      b. Mounted to building structure: Single hole pipe straps.
   2. Two or more parallel runs of raceway: Install trapeze support systems with 25 percent space (6 inches minimum) for future conduit runs. Refer to Section 260533 for spacing requirements.
   3. Welding conduit and conduit fittings to structure not acceptable.
   4. Spacing: Space so that fittings are accessible to accommodate pulling or splicing.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes conduit, electrical metallic tubing, wireway, surface metal raceway, and associated appurtenances within building perimeter.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

C. Refer to Section 260543 underground electrical work beyond building perimeter.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county and state codes and ordinances. Comply with local Utility requirements and standards.

B. Codes and Standards:
1. UL 1, Standard for Flexible Metal Conduit.
2. UL 5, Standard for Surface Metal Raceways and Fittings.
3. UL 6, Standard for Rigid Metal Conduit.
4. UL 360, Standard for Liquid-Tight Flexible Metal Conduit.
5. UL 514B, Standard for Conduit, Tubing, and Cable Fittings.
6. UL 651, Standard for Schedule 40 and 80 Rigid PVC Conduit.
7. UL 651A, Standard for Type EB and A Rigid PVC Conduit and HDPE Conduit.
8. UL 797, Standard for Metallic Tubing – Steel.
9. UL 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
10. UL 1242, Standard for Intermediate Metal Conduit – Steel.
11. UL 2420, Standard for RTRC Conduit and Fittings for underground – Fiberglass
12. UL 2515, Standard for RTRC Conduit and Fittings for above ground - Fiberglass

C. NEC Compliance: Comply with applicable portions of NEC as to type of products used and installation of electrical power connections.

D. Comply with applicable NEMA standards and refer to NEMA standards for definitions of terminology herein. Comply with NEC for workmanship and installation requirements of raceway systems.

E. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes specified and whose products have been in satisfactory use in similar service for not less than 3 years.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer’s technical product data for each type of raceway system and appurtenance.

PART 2 PRODUCTS

2.01 RIGID METAL CONDUIT (RMC) AND FITTINGS

A. Ferrous Metal Conduit: Steel, UL 6, hot-dip galvanized.

B. Fittings and Conduit Bodies: UL 514B, threaded galvanized.

2.02 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

A. Ferrous Metal Conduit: Steel, UL 1242, hot-dip galvanized.

B. Fittings and Conduit Bodies: UL 514B, threaded galvanized.

2.03 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Ferrous Metal Conduit: Steel, UL 797, hot-dip galvanized.

B. Fittings: UL 514B, galvanized steel, insulated throat, rain tight compression ring type or set screw type. Drive-on type and cast fittings not acceptable.

2.04 FLEXIBLE METAL CONDUIT AND FITTINGS

A. Ferrous Metal Conduit: Steel, UL 1, galvanized. UL listed for grounding as available. Aluminum and flexible metallic tubing not acceptable.

B. Fittings: Insulated throat, UL 514B, galvanized steel, UL listed for grounding as available.

2.05 LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

A. Ferrous Metal Conduit: Galvanized with PVC weatherproof cover, UL 360 listed for grounding as available.

B. Fittings: Insulated throat, UL 514B, galvanized steel, UL listed for grounding as available.

2.06 RIGID NON-METALLIC CONDUIT

A. PVC Conduit: Schedule 40, UL 651, rigid type unless noted otherwise. UL 651A Type A permitted for underground concrete duct banks.

B. Fittings: UL 651, UL 651A, UL 2420 and UL 2515.
   1. For electric (power) duct, 90 degree elbows with minimum 48 inch radius, factory manufactured rigid steel or Fiberglass (RTRC) with minimum 48 inch
   2. For telecommunications service provider ducts, 90 degree elbows with minimum 48 inch radius, factory manufactured rigid steel or Fiberglass (RTRC)
   3. For telecommunications on-site distribution ducts, 90 degree elbows with minimum 36 inch radius factory manufactured rigid steel (RMC)

2.07 SURFACE METAL RACEWAY

A. UL 5, sheet metal channel with fitted cover. Type and size as shown on the Drawings.

B. Finish: Enamel. Field paint to match wall color.

C. Fittings, Boxes, and Extension Rings: Designed for use with raceway systems.

D. All raceway and fittings to be supplied by one manufacturer.

E. Manufacturers: Mono-Systems, Wiremold, or approved.

2.08 CONDUIT BODIES

A. Conduit bodies cast malleable iron, zinc or cadmium plated with threaded connections. Covers gasketed, blank steel, or cast malleable iron, zinc or cadmium plated, and of same manufacturer as conduit body. Where conduit bodies are used as junction or splice boxes, comply with NEC.

B. Conduit bodies (Smart LB) for telecommunications cables shall be die cast aluminum, gray powder coat paint finish, threaded connections with internal built-in radius. Covers gasketed, die cast aluminum, and of same manufacturer as conduit body. Madison Electric or approved equal.

1. 1-1/4” Smart LB, Madison Electric, KLB120
2. 2-1/2” Smart LB, Madison Electric, KLB 250
3. 4” Smart LB, Madison Electric, KLB400

2.09 WIREWAY AND AUXILIARY GUTTER

A. UL 870, lay-in type, with hinged cover but without knockouts.

B. Size: As shown on the Drawings, 4 by 4 inch minimum.

C. Finish: Rust-inhibiting primer coat with manufacturer’s standard enamel finish.

2.10 EXPANSION FITTINGS

A. Malleable iron, hot-dip galvanized allowing 4 inches (plus or minus 2 inches) conduit movement. OZ/Gedney Type AX Series, Thomas and Betts Type EJG series or approved.

2.11 SEALING FITTINGS

A. Wall Sealing Fittings: At each wall sealing fitting, include conduit seal fitting, OZ/Gedney FSK Series or approved.

B. Raceway Stubups and Stubouts: Conduit seals together with wall sealing fittings. OZ/Gedney CSB Series or approved.

C. For Exterior Wall Penetrations below Grade: Include sealing bushing at interior end of penetrating raceway. Only threaded fittings are permitted in entering raceways ahead of sealing bushing. OZ/Gedney Type CSB or approved.

2.12 CONDUIT SUPPORTS

A. Conduit Clamps, Straps, and Supports: Steel or malleable iron. Comply with requirements in Section 260529.

2.13 FIRE RATED SEALING COMPOUND

A. Dow Corning 3-548 Silicone RTV Foam or approved.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.04 RACEWAY SIZING, ARRANGEMENT, AND SUPPORT

A. Unless otherwise shown on the Drawings, size conduit for conductor type installed. Minimum size 3/4 inch.

B. Install conduit to maintain headroom and present neat appearance in unfinished spaces. Install a minimum of 9’-6” above finished floor in spaces unless otherwise indicated on the Contract Drawings.

C. Install conduit concealed in walls, below floors, and above ceiling in spaces, except conduit may be exposed in mechanical rooms, electrical rooms, and similar unfinished spaces. Horizontal conduit installation is not allowed in floor slab unless specifically noted on electrical and structural drawings.

D. Route conduit parallel and perpendicular to building planes.

E. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, heating and hot water pipes, and heating appliances.

F. Brace conduit or conduit supports to prevent distortion of alignment by wire-pulling operations.

G. Where conduit is run in parallel, group on formed channel supports. Comply with requirements in Section 260529.

H. Do not fasten or support with wire or perforated pipe straps. Remove temporary conduit supports used during construction before conductors are pulled.

I. Raceway to be routed around structural members. Structural Engineer to approve proposed modifications of structural elements prior to commencement of work.

3.05 RACEWAY INSTALLATION

A. Cut conduit square using a saw or pipe cutter. Deburr cut ends.

B. Bring conduit to shoulder of fittings and couplings and tighten securely.

C. Use conduit hubs for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.

D. Do not use conduit bodies to make sharp changes in direction unless shown on the Drawings.

E. Use hydraulic one-shot conduit bender or factory elbows for bends in 2 inch conduit and larger.

F. Provide plastic bushings on conduit stubs used for transition from conduit to open cable runs.

G. During construction, use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

H. Distance Between Supports:
   1. Threaded Rigid Metal Raceways: Maximum ten foot centers and within 18 inches of each outlet, junction box, and bend.
   2. Electrical Metallic Tubing: Maximum ten foot centers at each bend and within 12 inches of each outlet, junction box, and coupling.
   3. Surface Metal Raceway, Auxiliary Gutter, and Wireway: Maximum 5 foot centers or in accordance with manufacturer's instruction, whichever is less, unless otherwise shown on the Drawings.

I. Provide polyester mule tape with printed footage indicators secured at each end of each empty conduit, except sleeves and nipples. Identify with tags at each end indicating origin and destination of empty conduit. Minimum tensile strength of 1250 pounds for conduits 2-inch and smaller and 2500 pounds for conduits larger than 2-inch.

J. Route conduit through roof inside openings for ductwork where possible. Otherwise, install through roof jack and seal weather tight.

K. Install no more than equivalent or four 90 degree bends between boxes.

L. Avoid moisture traps where possible. Where unavoidable, install junction box with drain fitting at conduit low point.

M. Raceway Installation below Slab on Grade:
   1. Installed a minimum of 2 inches below bottom of slab.
   2. Arrange and slope raceway to drain away from building.
   3. Install insulated grounding bushings at conduits stubbed up or out from underground unless capped for future (spare).
   4. Wipe PVC conduit clean and dry before jointing. Apply full even coat of cement to entire area to be inserted into fitting. Let joint cure for minimum 20 minutes.
   5. Install conduit that stub up through floor at such depth that exposed conduit is vertical and no curved section of elbow is visible.

N. Sealing of Conduit Penetrations:
   1. Exterior Wall Surfaces Above Grade: Seal around penetrations with caulking approved by the A/E. For concrete construction above ground level, cast conduit in wall or core drill wall and hard pack with mixture of equal parts of sand and cement.
   2. Exterior Wall Surfaces Below Grade: Cast conduit into wall (and floor) or use manufactured seal assembly cast in place.
   3. Roofs: Install mopped and flashing roof jack and where conduit penetrates roof membrane.
   4. Fire Rated Construction: Seal penetrations with fire rated sealing compound to maintain fire rating of construction penetrated.

O. Sealing of Raceways: Seal interior of raceways that pass through building roof and through outside walls of building, above or below grade. Seal on end inside building. Use raceway sealing fittings manufactured for purpose sealed with non-hardening, compound-type mastic, specially designed for such service. Pack around wires in raceways.

P. Raceways on exterior surface of building: nstall only when shown on the Drawings and as approved by the A/E.

Q. Where flexible metal or liquid tight flexible metal conduit is installed, install bonding conductor to insure electrical continuity of raceway. Route bonding jumper inside conduit and terminate at grounding bushing or grounding locknut installed on inside of junction boxes at each side of flexible section. In instances where this method is not feasible (such as when cast boxes with hubs are used or where required by the NEC, route bonding jumper on outside of flexible conduit and terminate in accordance with methods acceptable to the AHJ.

R. Raceway shall not penetrate sheet metal ducts.

S. Branch circuits: install overhead, except circuits serving floorboxes, outdoor circuits or unless indicated otherwise on the Contract Documents.

T. Support raceways below roof decking: provide minimum 1-1/2” separation from raceway surface to nearest surface of metal roof decking.

U. In finished areas with exposed structure, subject to the approval of the A/E, raceways may be installed exposed. Install raceways as high as possible, provide minimum 1-1/2” separation from raceway surface to nearest surface of metal roof decking, and neatly arranged. Submit shop drawing indicating routing of proposed surface raceways and boxes in finished areas.

3.06 SURFACE METAL RACEWAY INSTALLATION

A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.

B. Install insulating bushings and inserts at connections to outlets and corner fittings.

C. Maintain grounding continuity between raceway components for continuous grounding path.

D. Fastener Option: Use manufacturer’s standard clips and straps for installed purpose.

3.07 AUXILIARY GUTTER INSTALLATION

A. Bolt auxiliary gutter to steel channels fastened to wall or in self-supporting structure. Install level.

B. Gasket each joint in oil-tight gutter.

C. Mount rain tight gutter in horizontal position only.

3.08 RACEWAY SCHEDULE

A. Rigid Metal Conduit:
   1. Acceptable in all locations except as modified in this section.
   2. Where in contact with earth or concrete, install protective coating consisting of spirally wrapped 20 mil PVC tape with 1/2 inch minimum overlap – 3M Scotchrap Tape 51 or approved - or utilize PVC Coated Rigid Metal Conduit. Completely wrap and tape field joints.
   3. Required for exposed raceways in areas subject to physical damage

B. PVC Coated Rigid Metal Conduit:
   1. Required in corrosive environments or where indicated on the Contract Drawings.

C. Intermediate Metal Conduit:
   1. May be used in lieu of rigid metal conduit unless otherwise prohibited by code or indicated on the Contract Drawings.
   2. Not acceptable for circuits over 600 Volts.

D. Electrical Metallic Tubing:
   1. Acceptable for dry interior locations where not exposed to moisture or physical damage.
   2. Not acceptable for circuits over 600 Volts.

E. Rigid Non-Metallic Conduit:
   1. Acceptable below concrete slab on grade installed a minimum of 2 inches below bottom of slab.
   2. Acceptable within masonry walls.
   3. Not acceptable for exposed raceways extending through floor slab; utilize Rigid Metal Conduit.
   4. Not acceptable for bends 45 degrees and greater unless concrete encased; utilize Rigid Metal Conduit as specified herein, PVC Coated Rigid Metal Conduit or Fiberglass (RTRC). Field bends not acceptable.
   5. Concrete encased where indicated on Contract Drawings or where required by Code or Utility.

F. Flexible Steel Conduit:
   1. For connections to recessed light fixtures and devices installed in suspended ceilings, maximum six foot length.
   2. For connections to motors, transformers and other equipment subject to vibration. Minimum of three foot and maximum of six foot length with 90 degree loop.

G. Liquid-Tight Flexible Metal Conduit.
   1. For pump motors and equipment subject to vibration in damp and wet locations, in areas subject to being washed down, and for machinery where cutting oil is used. Minimum of three foot and maximum of six foot length with 90 degree loop.

H. Surface Metal and Multi-Outlet Raceway: Install where indicated on the Contract Drawings.

I. Auxiliary Gutters and Wireways: Install where indicated on the Contract Drawings and as required in unfinished spaces. Elsewhere as approved by the A/E.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes outlet, junction, and pull boxes and associated appurtenances required to enclose devices, permit pulling conductors, and for wire splices and branches.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NFPA 70, National Electrical Code (NEC).
   3. UL 514A, Metallic Outlet Boxes.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data for each type of outlet box and appurtenance.

PART 2 PRODUCTS

2.01 OUTLET BOXES FOR INTERIOR WIRING

A. General: Outlet and pull boxes pressed steel, zinc coated with plaster ring where applicable, minimum 4 inch size.

B. Surface Metal Raceway: Boxes of same manufacturer and to match raceway. Boxes shall accommodate standard devices and device plates.

C. Concrete and Masonry: Boxes for casting in concrete and mounting in masonry walls of type specifically designed for that purpose.

D. Ceiling Outlet Boxes: Galvanized octagonal 4 inch, 1-1/2 inches deep (without fixture stud) and 2-1/8 inch deep (with fixture stud).

E. Sheet Metal Boxes Larger than 12 Inches in any Dimension: Include hinged enclosure.

2.02 OUTLET BOXES FOR EXTERIOR WIRING

A. General: Weather resistant and rain tight, with appropriate covers, gaskets, and screws.

B. Above Grade: Outlet and junction boxes cast or malleable iron or cast of corrosion resistant alloy compatible with raceway to which they are connected. Pull boxes fabricated of hot dipped galvanized heavy gage steel. Boxes with gasketed covers.

C. Below Grade: Provide underground vaults as specified in Section 260543.

2.03 OUTLET BOXES CONTAINING MULTIPLE DEVICES

A. Outlet Boxes Containing Emergency and Normal Devices: Permitted only with steel barriers manufactured especially for purpose of dividing outlet box into 2 completely separate compartments.

B. Outlet Boxes Containing Multiple Devices and Wiring Rated over 150 Volts to Ground and Over 300 Volts Between Conductors: Permitted only with steel barrier manufactured especially for purpose of dividing outlet box into separate compartments for each device having exposed live parts.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.04 COORDINATION OF OUTLET BOX LOCATIONS

A. Locate as shown on the Drawings and as required to facilitate pulling. Limit number of bends per NEC.

B. Electrical box locations shown on the Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets before roughing in.

C. Locate outlet boxes to allow access. If inaccessible, furnish, arrange, and pay for installation of access doors.

D. Coordinate Work of this section with the Work of other sections and trades to avoid conflicts. Check and verify door swings and locations of built-in cabinets, plumbing, heating, and ventilating equipment.

E. Install outlet boxes of sizes and at locations necessary to serve equipment furnished under this or other divisions of the specifications. Make final connections thereto. Outlet boxes required if equipment is furnished with pigtail for external connection, does not have space to accommodate branch circuit wiring, or requires wire with insulation rating different from branch circuit wiring. Review equipment Shop Drawings for required outlet locations.

F. Where more than one outlet box is shown on the Drawings, and indicated to be at same elevation or one above the other, align them exactly on center lines horizontally or vertically. Relocate outlet boxes which are not so installed (including lighting, receptacle, power, signal, and temperature control outlets) at no additional cost to the Owner.

G. Centered on Built-In Work: In the case of doors, cabinets, recessed or similar features, or where outlet boxes are centered between such features, such as between door jamb and cabinet, make these outlet box locations exact. Relocate outlet boxes which are not centered.

H. Flush mount boxes with front edge of box or plaster ring even with finished surface of wall and ceiling, except those mounted above accessible ceilings and where surface mounting is permitted.

I. Locate to maintain headroom and to present a neat appearance.

J. Route conduit from switch and receptacle boxes in walls vertically to space above ceiling. Install junction box before horizontal run.

K. Offset outlet boxes minimum of one stud horizontal separation between flush boxes mounted on opposite sides of acoustic rated common wall.

L. Install outlet boxes with minimum 6 inch horizontal separation between closest edges of flush boxes mounted on opposite sides of common wall.

M. Ceiling Locations: Locate outlet either at corner joint or in center of a panel, whichever is closer to normal spacing. Locate outlet boxes in same room in same panel locations.

N. Conceal outlet boxes for electric water coolers behind cooler unit housing.

3.05 OUTLET BOX INSTALLATION

A. Anchor boxes so they will not shift or rock when devices are operated (including insertion and removal of cord caps).

B. Firmly anchor flush outlet boxes directly or with concealed bracing to studs and joists.

C. Close unused openings.

D. Support boxes independently of conduit except for cast outlet boxes that are connected to 2 rigid metal conduits, both supported within 12 inches of outlet box.

E. Use multiple-gang outlet boxes where 2 or more devices are mounted together. Do not use sectional boxes.

F. Install blank covers or plates over outlet boxes that do not contain devices.

G. In inaccessible ceiling areas, install outlet and junction boxes within 6 inches of recessed luminaire to be accessible through luminaire ceiling openings.

H. Install recessed outlet boxes in finished areas. Secure outlet boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall and adjustable steel channel fasteners for flush ceiling outlet boxes.

I. Install outlet boxes in walls without damaging wall insulation.

J. Seal conduit boxes, telephone boxes, and similar items air tight with acoustical caulk where located in acoustical rated walls that are not fire rated.

K. Install outlet boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for outlet boxes. Use outlet boxes with sufficient depth to permit conduit hubs to be located in masonry void space.

L. Install pull boxes to be accessible after completion of building construction.

3.06 ELECTRICAL WORK IN COUNTERBACKS, MILLWORK, AND CASEWORK

A. Install as shown on the Drawings. Furnish templates to other trades for drilling and cutting to ensure accurate location of electrical fixtures (outlets and devices) as verified with the A/E. Install wiring, devices, plates, and connections required by said fixtures.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes nameplates, wire and cable markers, conduit color coding, buried duct marking tape, and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards: NFPA 70, National Electrical Code (NEC).

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Nameplate schedule.

PART 2 PRODUCTS

2.01 IDENTIFICATION MATERIAL

A. Nameplates:
   1. Engraved three-layer laminated plastic.
      a. Normal Power: White letters on black background.
      b. NEC 700 System - Emergency Power: White letters on orange background.
      c. NEC 702 System – Optional Standby Power: White letters on green background.
   2. Control Panels and Equipment (Lighting and Receptacle Control): 1/2 inch high letters to identify equipment designation. 1/4 inch high letters to identify source, control panel name and space and zone controlled as designated on the Drawings..
   3. Enclosed Circuit Breakers, Disconnect Switches, Motor Starters: 1/4 inch high letters to identify load served and source.
   4. Emergency/Standby Power Boxes and Enclosures larger than six inches by six inches. 1/2 inch high letters to identify equipment and source designation.
   5. Digital Control Switches: 1/4 inch engraved letters on push button or cover to identify control zone.

B. Adhesive Printed Labels:
   1. Laminated tape – Brother TZe Series 12 mm width tape or equivalent with adhesive back suitable for exterior locations.
      a. Normal Power: Black letters on clear background.
      b. NEC 700 System Emergency Power: Orange letters on white background.
      c. NEC 702 System Emergency Power: Green letters on white background.
   2. Switches: 1/4 inch letters to identify load controlled.
   3. Receptacles: 1/4 inch letters to identify panelboard, circuit number and where identified as Dedicated, identify equipment designation as shown on panel schedule
   4. Lighting control devices: 1/4 inch letters to identify lighting control device designation as shown on shop drawings and lighting control program

C. Outlet boxes, junction boxes and pull boxes for emergency system devices and circuits orange in color, both inside and outside.

D. Outlet boxes, junction boxes and pull boxes for fire alarm system devices and conductors: red in color, both inside and outside.

E. Permanent felt marker for junction and pull box.
   1. Normal/Standby/Emergency Power: Black letters indicating circuit notation.
   2. Lighting controls: Black letters indicating “Lighting Control Device” and relays

F. Wire and Cable Markers:
   1. Split sleeve or tubing type. Vinyl impregnated cloth, vinyl, and mylar self-adhesive types not acceptable.
   2. Color code wire in accordance with the coding shown in Decal Detail below. Conductors of power systems in this building (plant) are identified as follows:

Conductor	208Y/120 Volt	480/277 Volt
A Phase (Left Bus In Panel):	Black	Brown
B Phase (Center Bus In Panel):	Red	Orange
C Phase (Right Bus In Panel):	Blue	Yellow
A Phase (Isolated Ground Circuit):	Black with yellow stripe	N/A
B Phase (Isolated Ground Circuit):	Red with yellow stripe	N/A
C Phase (Isolated Ground Circuit):	Blue with yellow stripe	N/A
Neutral:	White	Gray
Equipment Ground:	Green	Green
Isolated Ground:	Green with yellow stripe	N/A

   3. Where dedicated neutral conductors are provided for single phase circuits, neutral conductor shall have a colored stripe to match the color of the corresponding phase conductor.

G. Phase Identification: Vinyl colored electrical tape.

H. Electrical Hazard Marking Tape: Black and yellow striped vinyl 2 inch wide hazard tape, Identi-Tape #VH2BKY or equal.

I. Directory Cards: Directory cards shall consist of heavy cardstock, metallic mounting frames and plastic covers. Mounting frames attached to the back side of panelboard or lighting control panel doors. Directories shall contain typewritten text indicating the circuit breaker or control relay number, type of load served and room number in which each load is located. Unused circuit breakers or control relays designated with “SPARE” written in pencil. Spaces for future circuit breakers left blank. Circuit designations on directory cards shall match the installed conditions with respect to loads and physical arrangement within panelboards.

J. Wiring Color Code Schedules: Prepared using a color printer and laminated between two layers of clear plastic. Schedules shall show color designation for each phase, neutral and ground of each system voltage. Schedule size, 130 mm by 180 mm (5″ by 7″).

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. Description: Install, apply, erect, and perform work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, more stringent requirements govern.

B. Nameplates:
   1. Degrease and clean surfaces to receive nameplates.
   2. Install nameplates parallel to equipment lines.
   3. Secure nameplates to equipment fronts using screws or rivets. Adhesives not acceptable.

C. Wire Identification:
   1. Install wire markers on conductors in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
   2. Install solid colored jackets for wire sizes smaller than number 8 AWG. Wire sizes larger than number 10 AWG may be taped at both ends and at pull and junction boxes with appropriate colored tape. Color coding tape to completely encircle conductor at least 3 inches wide.

D. Felt Marker Identification: Apply on front of cover in non-finished areas, such as mechanical/electrical rooms, above ceilings, and similar locations, and on back of cover in finished areas.

E. Provide black and yellow striped vinyl 2” wide hazard tape on floor and stencil “Electrical Hazard-Keep Clear” on floor, spaced as to not exceed 4 feet on center to identify code required clearance in front of electrical equipment including switchboards, panelboards, motor control centers, transformers, transfer switches, etc. in unfinished spaces such as electrical and mechanical rooms.

3.04 INSTALLATION

A. General:
   1. Provide identification for electrical equipment as specified herein.
   2. Attach identification in durable manner, suitable to each respective type of identification. Securely fasten nameplates to equipment with two (2) rivets. Wiring color code schedules fastened to equipment with permanent adhesive.

B. Panelboards: Provide the following nameplates and schedules:
   1. Directory cards: Provide in each panelboard. Update room numbers and descriptions to match final owner approved room name/number. Place directory card in holder behind plastic cover.
   2. Provide a reduced copy of each panel schedule contained in the Contract Documents, showing actual configuration. Provided panel schedules in addition to the typewritten panelboard directories. Place schedules in directory frame.
   3. Provide a feeder tag nameplate attached to the exterior of each panelboard to identify the source feeder

C. Control Panels/Equipment:
   1. Nameplate: attach to the outside, front of enclosure for each relay panel, control units and control equipment. Nameplate text shall include the relay panel name or space and zone controlled as designated on the Drawings.

D. Motor Starters:
   1. Provide a nameplate on the outside, front of each starter and variable frequency drive enclosure. Nameplate text shall include the name of load served as designated on the Drawings.

E. Signaling and Communications Systems Cabinets:
   1. Provide a nameplate on the outside of each cabinet above door. Nameplate text shall include the system name as designated on the Drawings and the cabinet function.

F. Disconnect Switches:
   1. Provide a nameplate on the outside front of each disconnect switch enclosure. Nameplate text shall include the name of the load controlled as designated on the Drawings, and also the designation of the equipment that serves as the power source for the circuit that supplies the disconnect.
   2. Provide a feeder tag nameplate attached to the exterior of each disconnect that has overcurrent protection to identify the source feeder

G. Relays and Time Switches:
   1. Provide a nameplate on the outside front of each relay and time switch enclosure. Nameplate text shall include the name of the load controlled as designated on the Drawings.

H. Contactors:
   1. Provide a nameplate on the outside front of each contactor enclosure. Nameplate text shall include the contactor name as designated on the Drawings and the name of the load controlled.

I. Control Switches:
   1. Provide a nameplate for each equipment control switch with a device plate as specified in Section 262726. Nameplate text shall include the name of the load controlled as designated on the Drawings.
   2. Provide a nameplate or printed label on each control switch that does not have a device plate as specified in Section 262726. Verify type with Architect's Consultant. Text shall include the name of the load controlled as designated on the Drawings.

J. Wiring Devices:
   1. Receptacle Labels:
      a. Indicate panelboard and circuit number.

b. Where noted with subscript “D” indicating dedicated receptacle, provide label indicating equipment to be connected as noted in panel schedule e.g., refrigerator, microwave, copier, printer, etc.

c. Where noted with equipment description on plan drawing, provide label indicating equipment to be connected as spelled out in panel schedule e.g., refrigerator, microwave, copier, printer, etc.

2. Provide an engraved printed label for each switch that controls luminaires not within sight of the switch or that controls receptacles. Engraved printed label text shall include the type and location of the load controlled.

K. Junction Boxes and Pull Boxes:

1. Provide nameplates on the outside of the front cover of junction boxes and pull boxes in finished areas and of junction boxes and pull boxes that are larger than 150 mm by 150 mm (6″ by 6″). Nameplate text shall designate the system for which wiring is to be enclosed in the box. In the case of power system junction boxes or pull boxes, the nameplate text shall also include the panelboard name and circuit number.

2. Junction boxes and pull boxes 150 mm by 150 mm (6″ by 6″) or smaller in unfinished areas and above accessible ceilings must be color coded by spray painting the outside edges of the box and spray painting the cover with the following colors:

208Y/120 VAC Power:	Unpainted
480Y/277 VAC Power:	Tan
Fire Alarm & Detection:	Red
Security and Video Surveillance:	Purple
Telecommunications:	Blue
Intercom/Paging & Clock:	White
Television:	Black
Audio-video:	Gold
High Voltage – 600V and higher:	Yellow
NEC 700 Emergency System	Orange
NEC 702 Optional Standby System	Green

3. After painting, mark the covers of power system junction boxes and pull boxes with the panelboard name and circuit numbers. Marking must be done with a wide-tip, permanent-ink black marker.

L. Outlet Boxes:

1. Outlet boxes for emergency power and fire alarm circuits must be color coded by spray painting the box inside and outside with the following colors:

Fire Alarm & Detection:	Red
NEC 700 Emergency System	Orange
NEC 702 Optional Standby System	Green

M. Raceway systems:

1. NEC 700 Emergency Power: Provide adhesive label at intervals not exceeding 25 feet. Orange with black letters, “EMERGENCY SERVICE” Brady #44328 or approved. Where outlet boxes or enclosures are encountered within 25 feet, label not required.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes preparation of fault (short-circuit) calculations, protective device coordination study, and arc flash hazard analysis and labeling.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
1. IEEE C57.109, IEEE Guide for Transformers Through-Fault Current Duration.
2. IEEE 141, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book).
3. IEEE 241, IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (IEEE Gray Book).
4. IEEE 242, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book).
5. IEEE 1584, IEEE Guide for Performing Arc-Flash Hazard Calculations.
6. NFPA 70, National Electrical Code.
7. NFPA 70E, Standard for Electrical Safety in the Workplace.
8. ANSI Z535.4, American National Standard for Product Safety Signs and Labels.

C. Qualifications: Fault calculations, protective device coordination study and arc flash hazard analysis shall be prepared by electrical equipment manufacturer who furnishes incoming service equipment to building or an independent electrical engineer. In either case, calculations and study shall be stamped and signed by a professional engineer licensed in the state in which the Work is performed.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Identification of computer software program used for study.

C. Existing Conditions:
1. Serving utility information: Contact the utility to get all information upstream of the point of service required to perform the power study. Include the following:
    a. Customer owned primary metered system:
        1) Available Fault Duty at Meter/Point of Service.
        2) Available Fault Duty at upstream substation.
        3) Nearest upstream protective device type/size/settings.
        4) Conductor size/type, number of parallel runs and distance from Point of Service back to nearest upstream protective device.
2. Existing building distribution system includes the following information:
    a. Switchboards: Nameplate data including manufacturer make/model.
    b. Panelboards: Nameplate data including manufacturer make/model.

c. Transformers: Nameplate data including Impedance and winding ratio.
d. Feeders: Size, type (material and insulation type), length, number of parallel conductors, conduit type.
e. Overcurrent protection devices:
    1) Circuit Breakers:
        a) Manufacturer make/model and size.
        b) Largest circuit breaker size in each panel/switchboard.
        c) Trip Settings/Ranges.
        d) AIC Rating of lowest rated circuit breaker in each panel/switchboard.
    2) Fuses: Size and type.
f. Generators:
    1) Manufacturer and size.
    2) Transient & Sub-Transient info (xd, x', x", Td, T', T'').
    3) Decrement Curve.

D. Submit study outline.

E. Initial Submittals:
1. One-line diagram with each bus and node having a unique number indicating that fault calculation will be made at that point.
2. Representative one-line diagram of distribution system (with bus numbers as described herein) indicating which devices will be presented in protective device coordination study.

F. Following review and approval of the initial submittals by the A/E, submit final calculations and study in a common bound report.

G. Closeout Submittals:
1. Final report, in the following formats:
    a. Hard copy, bound.
    b. Soft copy, PDF format.
    c. Soft copy, native file(s) in format utilized by computer software program.

PART 2 PRODUCTS

2.01 GENERAL

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this section. Manual calculations are unacceptable.

B. The fault calculations protective device study and arc flash hazard analysis must include complete fault calculations for each proposed and ultimate source combination.

C. Source combinations may include present and future power company supply circuits, large motors, and generators.

D. Drawings and specifications indicate general requirements for electrical equipment being provided. Changes and additions may be suggested by results of study. Submit proposed changes and additions as a part of study.

2.02 FAULT (SHORT CIRCUIT) CALCULATIONS

A. Prepare description of calculation methods, assumptions, and base per unit quantities selected.

B. Prepare one-line diagram(s) and source impedance data including X/R ratio and power company system characteristics.

C. Prepare impedance diagrams, typical calculations, tabulations of calculation quantities, and results, conclusions, and recommendations.

D. Prepare calculations of short circuit interrupting and momentary (when applicable) duties for an assumed 3 phase, bolted, fault at medium voltage switchgear lineup, unit substation primary and secondary terminals, low voltage switchgear or switchboard lineup, motor control center, distribution panelboard, branch circuit panelboard, and other significant locations throughout system.

E. Prepare ground fault current calculations for the same system areas including associated zero sequence impedance diagram.

F. Prepare tabulations including fault impedance, X/R ratios, asymmetry factors, motor contributions, short circuit KVA, and symmetrical and asymmetrical fault currents.

2.03 PROTECTIVE DEVICE COORDINATION STUDY

A. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

B. Prepare time-current coordination curves graphically indicating proposed. Include upstream and downstream devices associated with each device to illustrate coordination. Include with each curve sheet a complete title and one-line diagram with legend identifying specific portions of system covered by that particular curve sheet.

C. Study shall incorporate all system protective device components.

D. Include detailed description of each protective device identifying its type, function, manufacturer, AIC rating, device tap, time-dial, pick-up, instantaneous, and time-delay settings.

E. Include on curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low voltage equipment circuit breaker and fuse characteristics, pertinent transfer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices.

F. Include, as a minimum, devices down to largest branch circuit and largest feeder circuit breaker in each piece of electrical gear or equipment.

G. Include recommended adjustable settings of overcurrent protective devices including but not limited to the following:
   1. Circuit breakers.
   2. Protective relays.
   3. Ground fault protection.
   4. Zone selective interlocking.

H. Include manufacturing tolerance and damage bands in plotted fuse characteristics.

I. Show transformer full load, 150, 400, and 600 percent current, transformer magnetizing inrush, transformer withstand parameters according to IEEE C57.109, and significant symmetrical or asymmetrical fault current to which device is exposed.

J. Select each primary protective device required for transformer winding configuration shown so that its operating band is within transformer characteristics including point equal to 59 percent of IEEE C57.109 to withstand point for secondary line-to-ground fault protection. Where primary device is not within transformer characteristics, show transformer damage curve.

K. Separate transformer primary protective device characteristic curves by a 16 percent current margin for coordination and protection in event of secondary line-to-line faults. Separate medium voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.

L. Prepare complete sets of individual protective device time-current coordination characteristics on transparencies.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine project overcurrent protective device submittals for compliance with fault calculation study, electrical device coordination and arc flash hazard labeling requirements and other conditions affecting performance.

B. Existing Condition Survey: Field investigate existing conditions to provide the information required for a complete power study from the Point of Service to all new and existing to remain equipment.

1. Serving utility information: Contact the utility to get all information upstream of the point of service required to perform the power study.

3.02 EQUIPMENT SHORT CIRCUIT CURRENT RATING

A. All mechanical equipment, packaged systems, control panels, motor starters, motor controllers, variable frequency drives and similar equipment shall carry a Short Circuit Current Rating (SCCR) equal to or greater than the available fault current delivered from the electrical system. Coordinate final available fault currents with the contractors providing this equipment.

3.03 ADJUSTING

A. After review by the A/E, make revisions to protective device settings to accomplish conformance with approval fault calculations and protective device coordination study. Provide final settings of all adjustable overcurrent devices in accordance with the coordination study.

3.04 DEMONSTRATION

A. Demonstrate to the A/E that correct device settings and ratings have been made. Include settings and ratings on the Record Drawings.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes testing requirements for individual components, equipment, systems, and integration to ensure intended facility operation. Test equipment per manufacturer guidelines and industry standards. Test modes of operation and interlocks and alarm functions. This section presents a guideline of system testing. Provide complete, comprehensive testing in addition to minimum requirements specified in individual sections and in this section.

B. Training: Include comprehensive Owner operation and maintenance training of individual components, equipment, and systems. Training includes normal operation and alternate modes of operations.

C. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. ANSI/NETA ATS 2017, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
   2. ANSI/NETA MTS-2015, Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems.
   3. NFPA 70B, Recommended Practice for Electrical Equipment Maintenance.
   4. NFPA 70, National Electrical Code (NEC).

C. Testing Agency: Testing shall be accomplished by an approved testing agency. Retain services of a NETA certified firm or approved. Testing agency shall not be associated with manufacturer of equipment or systems under test.

D. Perform testing and inspections with the assistance of a factory-authorized service representative, where indicated in individual specification sections.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Qualifications: Testing agency qualifications.

C. Testing Plan and Schedule: Detailed plan and schedule of testing, and training for acceptance by the Owner and the A/E prior to initiation of work.

D. Test Procedures: Test procedures and sample test forms.

E. Test Reports: Submit detailed report of testing functions with associated results. Include date of testing and corresponding line item for system tested and individual components. Include testing checklists for each system and device tested. Record for each line item test results that comply with requirements. Record for each line item test results that do not comply with requirements, corrective actions taken to achieve compliance with requirements and retest date and confirmation.

F. Settings of Adjustable Devices: Record as-left set points of all adjustable devices.

G. Include copy of reports in the Operation and Maintenance Manual.

H. Certification: Certification that tests have been completed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.04 GENERAL

A. Perform acceptance tests in accordance with manufacturer’s recommendations, NFPA 70 and ANSI/NETA ATS.

B. Report any system, material, or workmanship which is found defective on basis of electrical inspections and tests to the A/E.

C. If test reveals a fault or problem, remove and replace malfunctioning units. Repeat entire test until problem is corrected. Submit additional written test reports.

D. Maintain written record of tests. Upon completion of project, assemble and certify final test report and include in the Operation and Maintenance Manual. Compile field test reports signed by individuals performing the tests.

3.05 GENERAL COMPONENT AND EQUIPMENT TESTING REQUIREMENTS

A. Phase Relationship Tests: Check connections to existing and new equipment for proper phase relationship. During such check, disconnect devices which could be damaged by application of voltage or reversed phase rotation.

B. Grounding:

1. Test each ground electrode system. Comply with requirements in Sections 260526 and 260527.

2. Visual and Continuity Test: Perform for each of the following ground connections:
   a. Equipment ground connections.

C. Overcurrent Protective Device Calibration: Perform necessary field settings and adjustments to conform to the coordination study specified in Section 260573.

D. Receptacles: Test for open ground, reversed polarity, open hot, open neutral, hot and ground reversed, and hot on neutral.

3.06 LIGHTING CONTROLS TESTING

A. Test lighting controls, components and systems in accordance with local codes, manufacturer recommendations.

B. Test each device to confirm operation per manufacturer recommendations and design requirements.

C. Document each component, device and system tested and include “as-left” settings for all adjustable settings. Include a matrix which identifies device, type and location at a minimum.

3.07 REPORTS

A. Prepare test reports for each system, equipment and device tested. Include copy of each test report in the Operation and Maintenance Manual. Utilize test forms for systems and equipment tested. Use manufacturer’s standard or other appropriate test forms commensurate with test performed. Test reports shall include the following.
   1. Summary of project.
   2. Description of equipment tested.
   3. Description of test.
   4. Test results including retesting results.
   5. Test dates.
   6. Tester's name.
   7. Witnesses (when required).
   8. Corrective work.
   9. Acceptance criteria.
   10. Conclusions and recommendations.
   11. Appendix including appropriate test forms.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes design, furnish, and install of lighting control system(s) required to form complete coordinated system(s) ready for operation. Contract Documents indicate minimum scope and performance criteria. It is the responsibility of the lighting controls manufacturer/vendor/contractor to provide a complete system.

B. Analog lighting controls: Energy saving lighting control devices including wall switches, occupancy sensors with power supplies, emergency lighting transfer devices, daylighting controls, contactors and associated appurtenances.

C. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. NEMA 410, Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts.
   2. NFPA 70, National Electrical Code (NEC).
   3. UL 508, Standard for Industrial Control Panels.
   4. UL 916, Standard for Energy Management Equipment.
   5. UL 917, Standard for Clock Operated Switches.
   6. UL 924, Standard for Emergency Lighting and Power Equipment.
   7. Washington State Energy Code.

C. Comply with NEC, NEMA, and FCC emission requirements for Class A applications.

D. UL Approvals: Relay panels and accessory devices UL listed and labeled under UL 916. Custom relay panels UL listed and labeled under UL 508. Automatic load control relays UL listed and labeled under UL 924. Branch Circuit Emergency Lighting Transfer Switch UL listed and labeled under UL 1008.

E. Certification: Manufacturer shall certify that products will meet product specifications and local energy codes. If any additional equipment is required to meet coverage patterns and local energy codes, provide additional equipment at no additional cost to the Owner.

1.03 DESIGN/PERFORMANCE REQUIREMENTS

A. Design, furnish, and install complete operable lighting control system(s) in accordance with the latest adopted editions of energy code and Owner requirements.

B. Drawings reflect minimum Owner requirements. The Contractor’s scope of work shall include but not limited to the following:
   1. Complete lighting control system based on the available architectural, civil, structural, mechanical and electrical drawings.
   2. Wiring systems associated with lighting controls.

3. Providing additional occupancy sensors, photo sensors, daylight sensors, low voltage switches, relays, dimming modules, UL 924 control devices, control panels, and power supplies associated with lighting controls system.

1.04 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data and maintenance data for each type of lighting control system and components. Include digital cable, analog cable, termination types, wire connectors, manufacturer specific back boxes/supporting equipment.

C. Shop Drawings:
   1. Floor plans showing wall occupancy sensors, light switches, relays, contactors, power supplies, dimming modules, and mechanical control interface locations. Include typical installation and mounting diagrams. Above ceiling devices to be shown on the floor plans.
   2. Reflected ceiling plans showing occupancy sensors, daylighting sensor. Include typical installation and mounting diagrams for occupancy control devices.
   3. Detailed point to point wiring diagrams.
   4. System one-line diagram showing panels, number and types of switches and sensors, and building energy management system interface.
   5. Request for engraved switch verbiage
   6. Drawings for each panel showing hardware configuration and numbering.
   7. Panel wiring schedules.
   8. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.

D. Commissioning/Test Reports:
   1. Field Test Reports.
   2. Commissioning Plan with Test Procedures.

E. Closeout Submittals:
   1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
   2. Operation and Maintenance Manual:
      a. Include approved Shop Drawings and Product Data.
      b. Engraved switch identification.
      c. Include Sequence of Operation, identifying operation for each room/ space and accent lights.
      d. Include manufacturer's maintenance information.
      e. Operation and Maintenance Data: Include detailed information on device programming and setup.
      f. Include startup and test reports.

1.05 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.

B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).

2. Relative humidity: Maximum 90 percent, non-condensing.

1.06 WARRANTY

A. Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Analog Lighting Control: Components with single use function, subject to compliance with requirements, Leviton, Sensor Switch, Lutron, Wattstopper, Hubbell.

2.02 SYSTEM DESCRIPTION

A. Space Control System: Electrically operated, electrically supervised, lighting control system as described herein. Include control units, power supplies, relays, dimming output control devices, input control devices including occupancy sensors, photo sensors and control switches, wiring, cabling, conduit, fittings, and accessories required for a complete operating system.

B. System Types (indicated in the contract documents):
   1. Analog control: Single function analog devices to control lighting fixture and/or plug loads. Provide devices to match the lighting and plug load control requirements indicated in contract documents.
      a. Analog control devices:
         1) Line voltage control devices receive input from analog low voltage control devices and include the following:
            a) On/Off universal voltage power pack.
            b) Plug load control on/off universal voltage power pack.
         2) Low voltage control devices provide inputs to line voltage control devices or directly to light fixtures and include:
            a) Occupancy sensors.
            b) Photo sensors.
            c) Momentary contact On/Off Switches.
            d) Occupancy sensor control switches.

C. Comply with requirements in Section 260533 for raceways, Section 260519 for conductors and wiring, Section 260534 for outlet boxes, and Section 260529 for supports. System cabling requirements shall meet manufacturer standards.

D. Enclose entire lighting control system wiring in raceways.

E. Control: The system shall have control devices to perform automatic and/or manual control functions indicated on the drawings and defined below. The control devices shall be capable of being controlled by any system input device type as well as by building control system DDC/BMS. The system shall also be capable of providing sequence of operations functions indicated on the drawings.
   1. Occupancy Sensor Control: Provide occupancy sensors for on/off control with manual dimming of light fixtures in as indicated on drawings. Control shall function as vacancy sensors with Manual-ON functionality or occupancy sensors with Automatic–ON functionality.
   2. Dimming Control Requirements: Provide automatic dimming for each light fixture in daylight areas and manual dimming zones as indicated on lighting zone control drawings.

3. Manual On/Off Control: Provide control devices to turn on/off all light fixtures within manual control zones as indicated in the drawings.
4. Timeclock Control Requirements: Provide dry contact inputs from DDC System for on/off control based on time of day as indicated in drawings.
5. Egress Lighting Control: Provide dedicated control devices for all egress lights within each control zone indicated in the drawings. Egress light fixtures shall be on anytime the building is occupied. Control of egress light fixture shall be with time of day.

2.03 EQUIPMENT

A. Timeclocks: Connect to existing time clock.

B. Contactors: Utilize existing contactors.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.03 INSTALLATION

A. Install system in accordance with the drawings, this section, Sections 260511, 260519, 260553, 262726, applicable codes and manufacturer's recommendations. Install wiring in compliance with NEC for power and non-power limited signaling circuits. Upon completion, certify in writing to the Owner and general contractor that system has been installed in compliance with NEC.

B. Test conductors for ground conditions before making final wiring connections. Comply with requirements in Section 260526.

C. Maintain wiring color code throughout installation. Include color code identification in the Operation and Maintenance Manual.

D. Coordinate with appropriate subcontractors for installation of equipment and devices that pertain to other work in the contract.

E. Clean dirt and debris from inside and outside of the equipment after completion of installation.

F. All line voltage connections shall be tagged to indicate circuit and switched legs.

G. Test all devices to ensure proper communication.

H. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

I. Post Start-up Tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy.

J. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

K. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

L. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to controllers.

3.04 IDENTIFICATION

A. Identify components, power and control wiring according to Division 26 Section "Electrical Identification".

B. Identify controlled circuits in Directory Cards.

C. Provide engraved nameplate to identify time switches and contactors with a unique designation.

D. Provide engraved push buttons on digital switches, confirm switch labels with owner.

E. Provide printed labels on ceiling tiles or grid runners below all above ceiling mounted control devices.

F. Provide printed labels on Control Relays and modules to indicate controlled loads.

3.05 CONTRACTOR COMMISSIONING

A. Upon completion of initial contractor self-commissioning, the contractor shall coordinate system commissioning by the manufacturer's factory authorized representative who shall verify the system is complete and fully functional.

B. Provide computer generated documentation on the commissioning of the system with room by room description including:
   1. Sensor parameters, time delays, sensitivities, daylighting set points.
   2. Sequence of operations (e.g. Manual On, Auto OFF, etc.).
   3. Load Parameters (e.g. blink warning, etc.).
   4. Re-commissioning – After 30 days from occupancy, recalibrate occupancy/vacancy sensor time delay settings, occupancy/vacancy sensor sensitivity settings and photo sensor light level settings. Provide detailed report to A/E for review.

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.
   1. Verify Class I and II wiring connections are terminated properly by validating system performance.

2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
3. Verify/complete task programming for all switches, dimmers, time clocks, and sensors.
4. Verify that the control of each space complies with the Sequence of Operation.
5. Correct any system issues and retest.

C. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:
1. Date of test or inspection.
2. Loads per space, or Fixture Address identification.
3. Quantity and Type of each device installed.
4. Reports providing each device's settings.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes wall switches, receptacles, device plates, box covers, and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. Federal Specification W-C-596, Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
   2. Federal Specification W-S-896, Switch, Toggle.
   3. NEMA WD 1, General Color Requirements for Wiring Devices.
   4. NFPA 70, National Electrical Code (NEC).
   5. UL 498, Standard for Attachment Plugs and Receptacles.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data for each type of wiring device and appurtenance.

C. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 PRODUCTS

2.01 WALL SWITCHES

A. Manufacturers: Leviton, Bryant Electric, Hubbell, Pass and Seymour, or approved. Leviton model numbers are listed.

B. Finish: Match Existing.

C. Wall Switches for Lighting Circuits: NEMA WD 1. General use snap switch with colored toggle handle rated 20 Amps and 120/277 Volts AC. Switch with back and side wired screw type terminals. Units specification grade.
   1. Single-Pole Toggle Switch: Leviton Model 1221-2.
   2. Double-Pole Toggle Switch: Leviton Model 1222-2.
   3. Three-Way Toggle Switch: Leviton Model 1223-2.
   4. Four-Way Toggle Switch: Leviton Model 1224-2.

D. Momentary Contact Line Voltage Switches: Single pole, double throw, 3-wire, normally open. Rating same as for wall switches. Leviton Model 1257.

E. Weatherproof: Switches mounted in a cast metal box with gasketed, weatherproof device plate.

2.02 LOW VOLTAGE CONTROL

A. Manufacturer: General Electric, Square-D, Cutler Hammer, Siemens, or approved.
   1. Relays: General Electric Type RR-7.
   2. Switches: General Electric Type RTS-5.
   3. Transformers: General Electric Type RT1 and RT2.
   4. Rectifiers: General Electric Type RA16.
   5. Device Plates: As specified in Article “Device Plates”.
   6. Finish: White.

B. Wire: Copper conductor for low voltage control purpose furnished by supplier of low voltage relays and switches.

2.03 RECEPTACLES

A. Manufacturers: Leviton, Bryant Electric, Crouse Hinds, Hubbell, Pass and Seymour, or approved. Leviton model numbers are listed.

B. Finish: Match existing.

C. Convenience and Straight-Blade Receptacles: NEMA WD 1. Units specification grade.

D. Convenience Receptacle Configuration: (20A-125V NEMA 5-20R) straight blade with grounding type with, back and side wired screw type terminals.
   1. Duplex Receptacle: Leviton Model 5362.
   2. Single Receptacle: Leviton Model 5361.
   3. GFCI Receptacles: Duplex convenience receptacle with integral ground fault circuit interrupter. Units feed-through type for downstream device protection. Leviton Model GFNT2.

2.04 DEVICE PLATES

A. Manufacturers: Bryant Electric, Hubbell, Leviton, Pass and Seymour, or approved. Bryant Electric and Leviton model numbers are listed.

B. Plates in Finished Areas: Type 302 non-magnetic stainless steel except as noted below:
   1. Wall plates for isolated ground receptacles to be with 1/4 inch specially engraved black letters “COMPUTER ONLY”.
   2. Wall plates for emergency receptacles with 1/4 inch red letters “EMERGENCY”. Leviton 84003-E40.
   3. Wall plates for dedicated receptacles with 1/4 inch specially engraved black letters “DEDICATED”.
   4. Wall plates for receptacles protected by a GFCI circuit breaker or feed through GFCI receptacle with 1/4 inch specially engraved black letters “GFCI PROTECTED”. Leviton 84003-G40.
   5. Wall plates for receptacles other than NEMA 5-20R with 1/4 inch specially engraved black letters which show ampere rating, voltage, and phase.

C. Plates on Surface Mounted Boxes: Sized to fit box without extending over sides of box.

D. Cast Metal Plates: Cast metal box. Steel plates with steel boxes and copper-free aluminum with aluminum boxes. Stainless steel screws.

E. Raised Sheet Steel Plates: 1/2 inch high zinc or cad-plated covers with surface mounted sheet steel boxes.

F. Weather Resistant Cover Plate:
   1. While In-Use Cover: Cast metal with hinged gasketed device covers. Leviton IUM1V-GY unless otherwise noted.
   2. Not In-Use Cover: Cast metal with hinged gasketed device covers. Leviton WM1V-GY, only where noted on contract drawings.

G. Finish of Attachment Screws: Match that of its respective device plate.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.04 WIRING DEVICE INSTALLATION

A. Install wiring devices in clean electrical boxes, free from excess building materials, dirt, and debris.

B. Install jumbo size plates for outlets in masonry walls.

C. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

D. Install devices and wall plates flush and level.

E. Fasten each device to outlet box at wall surface to bring receptacle flush with plate or for switch handle the proper distance through plate.

3.05 ORIENTATION

A. Install switches vertical with handle operating vertically, up position "ON". Install center at 44 inches above finished floor unless noted otherwise on the Drawings.

B. Install receptacles vertical with ground slot up centered at 18 inches above finished floor and 6 inches above counters.

C. Install exterior receptacles vertical with ground slot up centered at 18 inches above finished grade.

3.06 RECEPTACLE GROUNDING

A. Install bare bonding wire between receptacle grounding terminal and box. Plaster ear screws connecting frame to box not acceptable for grounding.

3.07 HANDICAPPED ACCESS

A. Comply with requirements of Washington State Handicapped Access Code.

3.08 FIELD QUALITY CONTROL

A. Comply with requirements in Section 260810. Include copy of field test reports in the Operation and Maintenance Manual.

B. Prior to energizing circuitry, test wiring devices for electrical continuity and polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes overcurrent protective devices for operation at 600 Volts and below, including circuit breakers and fuses as individual components in separate enclosures and for installation as integral components of switchboards and panelboards and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards: NFPA 70, National Electrical Code (NEC).

C. Comply with NEMA and ANSI standards as applicable to construction and installation of overcurrent protective devices.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data on overcurrent protective devices, including catalog cuts, time-current trip characteristic curves, and mounting requirements.

C. Shop Drawings: Include layouts of circuit breakers with spatial relationships to proximate equipment.

D. Closeout Submittals:
   1. Written confirmation that all circuit breaker settings were adjusted to match the power studies final report.

E. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

1.04 EXTRA MATERIALS

A. Fuses: For each type and rating, furnish additional fuses amounting to 1 unit for every 5 units installed, but not less than 2 units of each size and type.

B. Spare Fuse Cabinet: Provide one, sized to house spare fuses provided under this contract plus 25% additional space for future.

C. Electronic Trip Unit Test Set: Furnish one set, including associated software, capable of testing each circuit breaker type.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Circuit Breakers: Square D, Eaton/Cutler Hammer, General Electric, Siemens or approved. Circuit breaker manufacturer shall be same as panelboard and switchboard manufacturer when installed therein.

B. Fusible Circuit Breakers: Bussmann Mfg. Co.

C. Fuses: Bussmann Mfg. Co. or Mersen Electrical Power. No substitutions. Fuses shall be by one manufacturer.

2.02 CIRCUIT BREAKERS

A. General:
   1. UL 489 fixed mounted molded case type with unless indicated otherwise.
   2. Overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication.
   3. Common trip for two and three pole circuit breakers. Handle ties, manufactured by circuit breaker manufacturer, permitted for multi-wire branch circuits on approval of samples.
   4. Trip ratings imprinted on handle or visible through deadfront cover.
   5. Constructed for mounting and operating in any physical position and calibrated for operation in ambient temperature up to 40 C.
   6. Mechanical screw type removable connector lugs, AL/CU rated, to accommodate conductors specified. Rated for 75 C conductors for 60 Amp and larger circuit breakers.
   7. Amperage and Voltage as indicated.
   8. Short circuit rating: RMS interrupting rating as indicated. Minimum 10,000 AIC rating at 120, 208 and 240 Volts. Minimum 14,000 AIC rating at 277 and 480 Volts.
   9. Ground Fault Interrupter (GFI) circuit breakers: Equipped with integral ground fault interrupter set to trip on ground fault of thirty milliamps or greater.
   10. Ground Fault Circuit Interrupter (GFCI) circuit breakers: Equipped with integral Class A ground fault circuit interrupter set to trip on ground fault of six milliamps or greater.
   11. Arc Fault Circuit Interrupter (AFCI) where indicated.
   12. Switching rated for 120 Volt and 277 Volt lighting branch circuits.
   13. HACR rating where serving air conditioning and refrigeration equipment.
   14. Current limiting, utilizing non-fuse type current limiting, where indicated.
   15. Tandem-mounted circuit breakers not acceptable.
   16. Minimum Frame Size: To match trip rating, unless indicated otherwise.
   17. Keyed Interlocks: Externally-mounted and arranged to prohibit interlocked circuit breaker operation, except in a specified sequence. Include mountings and hardware. Provide nameplates at each keyed interlock indicating interlocked circuit breaker and sequence of operation.
   18. Zone-Selective Interlocking: Integral with ground fault trip unit for interlocking ground fault protection function.
   19. Arc Energy Reduction: Provide energy-reducing maintenance switch with local status indicator for use as a temporary arc-flash incident energy-reduction device during maintenance activities. Provide for each circuit breaker with a frame size 1200 Amps and larger and as indicated.
       a. Provide a manual switch on the compartment door to switch the circuit-breaker short-time tripping characteristics to instantaneous with minimum pickup setting, to reduce the danger from potential arc-flash at downstream equipment.

b. Provide a lock feature for the switch so that it may be locked in either the off or on maintenance-mode position.
c. Provide a blue LED indicating light to indicate that the switch is in maintenance mode.
d. Provide dry relay contacts on each switch for annunciation of the switch position.

2.03 TRIP UNITS

A. General:
1. Thermal magnetic unless indicated otherwise.
2. Electronic Trip Unit: Required for circuit breakers:
a. Sized 400 Amps and larger on 480 Volt systems.
b. Sized 800 Amps and larger on systems 250 Volts and lower.
c. Sized 100 Amps and larger serving emergency and legally-required standby systems and equipment.
d. Power circuit breakers.
e. Insulated case circuit breakers.
f. Where indicated or specified.
g. Where required by the Selective Coordination Study.

B. Thermal Magnetic Trip Unit: Adjustable magnetic trip setting for sizes 250 Amps and larger.

2.04 FUSES

A. General:
1. Fuses of type, sizes, ratings, and electrical characteristics of single manufacturer.
2. Fuses labeled UL Class L, UL Class R, current limiting, rated for up to 200,000 Amps.

B. Where fuses are shown on the Drawings feeding individual or groups of equipment items, comply with manufacturer's recommendation for fusing. Adjust fuse size and type to comply with manufacturer's recommendation.

C. Main Service, Feeder and Branch Circuit Fuses:
1. For fuse ratings over 600 Amps: UL Class L (KRP-C or A4BY).
2. For fuse ratings up to 600 Amps: UL Class RK1 (KTN-R, KTS-R or A2K-R, A6K-R).
3. Feeder or branch circuit directly feeding motors, transformers, and other inductive load: UL RK5 time delay (FRN-R, FRS-R or TR-R or TRS-R).
4. Other Branch Circuits: UL Class RK1, (KTN-R, KTS-R or A2K-R, A6K-R).

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.04 CIRCUIT BREAKERS

A. Install in panelboards, switchboards and enclosures, in accordance with the manufacturer's recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards.

B. Install handle ties for multiwire branch circuits per Section 260519.

C. Device Settings: Adjust in accordance with the Electrical Power Studies report from Section 260573, including but not limited to the following:
   1. Circuit Breakers.
   2. Zone selective interlocking.

3.05 FUSES

A. Install fuses in switches, panelboards, switchboards and enclosures. Install fuses so current rating is visible from front when cover is open.

B. Do not install until equipment is ready to be energized.

C. Coordinate with equipment furnished by others for proper fuse type and size.

D. For motor and equipment circuits, fuse sizes shown on the Contract Drawings are for general guidance only. Size fuses in accordance with fuse manufacturer’s recommendation for given motor nameplate ampere rating. Test operation. If nuisance tripping occurs, increase fuse size and disconnect device (if necessary) for nuisance free tripping. Adjust fuse size for ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times.

3.06 FIELD QUALITY CONTROL

A. Test circuit breakers as specified in Section 260810.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes disconnect switches and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. NFPA 70, National Electrical Code (NEC).
   2. UL 98, Enclosed and Dead-Front Switches.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data and maintenance data for each type of equipment and appurtenance. Include equipment characteristics such as ratings, enclosure type, dimensions and weight.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Disconnect Switches and Enclosed Circuit Breakers: Square D, Eaton/Cutler Hammer, General Electric, Siemens, or approved.

2.02 GENERAL

A. Ratings: Voltage, Amperage and horsepower rating suitable for circuit and equipment controlled. Service entrance rated where indicated or required.

B. Enclosures: Surface-mounted.
   1. NEMA Type 1, in general.
   2. NEMA Type 3R where exposed to moisture and where shown on the Drawings.

C. Accessories:
   1. Padlockable in "OFF" position.
   2. Labeled "ON"/"OFF" position.
   3. Ground lug.
   4. Neutral lug where applicable.
   5. Other accessories as indicated.

D. Nameplates: Per Section 260553.

2.03 DISCONNECT SWITCHES

A. General: Heavy duty, UL 98, horsepower rated with external handle.

B. Interlock: Defeatable door interlock that prevent door from opening when operating handle is in "ON" position.

C. Fusible or non-fusible as indicated. Fuse rejection clips where Class R fuses are specified.

D. Quick-make, quick-break mechanism. Visible blades.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Comply with applicable requirements of NEC, NEMA and NECA standards, and with recognized industry practice. Where these may be in conflict, the more stringent requirements govern.

B. Install where indicated on the Contract Drawings and where required. Mount independent of equipment served; do not attach to equipment served.

C. Coordinate installation work with electrical raceway, wire, and cable work as necessary for proper interface. Comply with requirements in Section 260533.

D. Install within sight of equipment or controller served.

E. Where locations are not shown on Contract Drawings, locate on wall adjacent to equipment being served or on formed steel channel frame at face of equipment. Coordinate location to maintain equipment clearances.

3.04 FIELD QUALITY CONTROL

A. Comply with requirements in Section 260810. Include copy of field test reports in the Operation and Maintenance Manual.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes motor controls for electrical motor driven equipment and associated appurtenances. Refer to Section 260511 for electrical mechanical coordination and responsibilities.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work of this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Code and Standards:
   1. NFPA 70, National Electrical Code (NEC).
   2. UL 98, Enclosed and Dead-Front Switches.
   3. UL 489, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
   4. UL 508, Industrial Control Equipment.

C. Comply with NEMA for appropriate size of motor protection. For units not using NEMA rating, use equivalent NEMA size.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: For each type and size of motor controller and appurtenance.

C. Shop Drawings: Wiring diagrams for each type and size of motor controller.

1.04 SPARE MATERIALS

A. Include one spare starter coil for each starter size specified.

1.05 MOTOR VOLTAGE INFORMATION

A. Voltages available: 115, 208 and 277 Volt, single phase and 208 and 480 Volt, 3 phase.

B. Circuits designed (in general) for Motors as follows:
   1. Smaller than 3/4 HP: 115, 208 or 277 Volts, single phase.
   2. 3/4 HP and Larger: 208 or 480 Volts, 3 phase.

C. Verify motor sizes and voltages provided under other divisions and notify the A/E if any discrepancies are noted.

PART 2 PRODUCTS

2.01 GENERAL

A. Size starters as indicated on the Drawings and specified in this section. Coordinate starter sizes with associated motors and furnish starters matched to motor horsepower.

2.02 MANUFACTURERS

A. Manufacturers: Cerus Industrial Building Automation Starter, Square D, Eaton/Cutler Hammer, General Electric, Siemens, Allen-Bradley, or approved.

2.03 MOTOR STARTERS

A. Magnetic Motor Starter:
   1. General: NEMA rated. NEMA size rated for motor horsepower or as indicated, NEMA size 1 minimum. Full-voltage, non-reversing (FVNR), unless indicated otherwise. Full-voltage, non-reversing (FVNR), unless indicated otherwise.
   2. Enclosure: Surface-mounted, NEMA 1 enclosure for indoor and NEMA 3R for locations subject to moisture, unless indicated otherwise.
   3. Contactor and Overload Relay: Contactor with minimum 1 NO and 1 NC auxiliary contact and solid state electronic overload relay to protect all phases with field adjustable current setting and trip class for specific motor full load amps. Overload relay with phase failure, phase loss, locked rotor, and stall protection. Include manual reset pushbutton on starter cover to restore normal operation after trip or fault condition.
   4. Integral Control Power Transformer: 50 VA capacity with circuit breaker protected secondary selected for available line voltage and maximum 120 Volt control voltage.
   5. Automation System Control: Include remote run terminals in starter to accept voltage input signal and contact closure. Input voltage shall accept 24 VAC, 120 VAC, 24 VDC, and 48 VDC to allow direct connection of input signal to starter.
   6. Interlocks: Where motor is interlocked with a control damper or control valve, actuator control shall reside within starter enclosure. Starter shall provide voltage output to operate actuator without closing motor circuit. Starter shall close motor circuit and start motor upon receipt of contact closure from limit or end switch confirming control damper or control valve position.

B. Combination Magnetic Starter: Include magnetic motor starter requirements previously specified and a disconnecting method by means of motor circuit protection, UL 489 circuit breaker, or fused disconnect. Include disconnect with lock-out mechanism when starter is in “OFF” position. Disconnecting method as follows:
   1. Current limiting manual motor starter with magnetic trip elements, UL 508 listed. Breaker with UL 508 Type F rating for maximum 100 Amp frame size. Coordinate short circuit rating for use with motor contactor with 30,000 AIC minimum interrupting rating for combination starter.
   2. Fused disconnect with time delay J-style fuses, UL 98 suitable for service entrance protection.
   3. UL 489 breaker with thermal and magnetic mechanisms.

C. Manual Motor Starter: Horsepower-rated toggle switch type, lockable in the “OFF” position, with melting alloy overload relays, red “running” pilot light, nameplate and enclosure. Square D, Class 2510 or equivalent.
   1. Enclosures: Surface-mounted, NEMA 1 enclosure for indoor and NEMA 3R for locations subject to moisture, unless indicated otherwise.
   2. Acceptable for single-phase motors of 1 horsepower and smaller. Not acceptable for 3 phase motors.

D. Pushbuttons, Selector Switches, Pilot Lights, and Similar Devices: Include “HAND”, “OFF”, “AUTO” operation switch and watertight and dust-tight LED pilot lights for “HAND”, “OFF”, “AUTO”, “RUN”, and “OVERLOAD” conditions.

E. Overload Relays: Electronic solid state, sized for nameplate ampacity of motor served.

2.04 ADDITIONAL FEATURES

A. Include the following features to meet design performance:
   1. Over and under voltage and phase monitoring, field adjustable for over and under voltage levels. Include time delay before returning to normal operation after trip occurrence.
   2. Measure and display output current on front cover.
   3. Monitor and calculate power consumption (kWh) of motor load and display kW and kWh. Include pulse output (kWh) or 4 to 20 mA analog signal (kW) to automation system to monitor power consumption.
   4. Communication to automation system over BACnet MS/TP to report starter mode, terminal input status, run status, and fault status, voltage, current, power factor, kW, and kWh.

B. Power Factor Correction: Include capacitors for motors 25 horsepower and larger. Size to bring power factor to within range of 0.9 to 0.95. Capacitors fused type with blown fuse indicators mounted on front of starter enclosure. Include discharge resistors when required by NEC.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.04 MOTOR CONTROLLER INSTALLATION

A. Install generally in location shown on the Drawings with exact location chosen to provide necessary code clearances and to preserve maintenance access.

B. In finished areas, install motor protection switches flush and provide suitable stainless steel coverplates.

C. Install on steel frame anchored to the structure adjacent to, but independent of equipment served. Do not fasten to motor, mechanical equipment enclosure, or related supports.

D. For roof-mounted equipment, coordinate supports with architectural and structural to maintain roof integrity. Submit shop drawings.

E. Check for proper motor rotation and reconnect conductors as necessary to provide proper rotation.

F. Comply with requirements in Section 260553 for nameplates.

G. Install fuses in fuseholder so fuse size is visible.

H. Prior to air and water system balancing, verify overload relays match motor nameplate rating. After balancing, adjust overload settings to match actual motor current.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes interior and exterior luminaires, lamps, ballasts/drivers and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01, and Sections 260500, and 260510 apply to Work in this section.

C. Comply with requirements in other specification sections for concrete used for embedding poles, pole foundations, and footings for exterior area luminaire poles, standards, and foundations. Pole bases included in this section.

D. Where conflict occurs, the Luminaire (Light Fixture) Schedule shall take precedence.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards: NFPA 70, National Electrical Code (NEC), including local amendments, as applicable.

C. Comply with NEC and NEMA for installation and construction of luminaires. Components, Devices and Accessories shall be listed and labeled for intended use as defined in NEC, by a qualified testing agency and acceptable to the AHJ. Luminaires shall be UL listed and be labeled.

D. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

E. Each lamp type shall be of the same manufacturer.

F. Each ballast type shall be of the same manufacturer.

G. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

H. Luminaires in damp or wet locations shall be listed for such use and labeled as either "Suitable for Damp Locations" or "Suitable for Wet Locations".

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data and maintenance data for each type of luminaire and appurtenance.
   1. Submit product data for associated lamp, ballast (or driver) for each luminaire type.
   2. Create a matrix encompassing all luminaire types with ballast and lamp type, including manufacturer name and part number(s).
   3. Submit copy of individual and/or tandem warranties for luminaire, lamp and ballast (or driver), as applicable.

4. For solid state lamps:
   a. Provide IES LM-79 report.
   b. Provide IES TM-21 report.
   c. Provide Bin Coding System Chart, with appropriate target CCT reference line, identifying which bin corresponds to the lamps supplied to each luminaire. For luminaires with multiple solid state lamps, identify which bins shall be included for color mixing.

C. Qualifications: Indicate manufacturer qualifications as identified in Part 2.

D. Shop Drawings:
   1. Submit dimensioned drawings of each type of luminaire. Submit in booklet form with separate sheet for each luminaire, assembled by luminaire "type" in alphabetical order with proposed luminaire and appurtenances clearly indicated on each sheet.
   2. Submit support and hanging details for luminaires weighing more than 56 pounds and pendant hung luminaires requiring support design approved by the AHJ.
   3. Submit copy of manufacturer installation instructions for each luminaire type.

E. Test Reports:
   1. Comply with commissioning requirements in Section 260810.
   2. Perform field test reports.
   3. Submit completed copy of reports at the time of substantial completion. Include copy in the Operation and Maintenance Manual.

1.04 EXTRA MATERIALS

A. Turn over to the Owner and obtain signed receipt.

B. Include copy of transmittal(s) and receipt(s) in Operation and Maintenance Manual.

C. Drivers:
   1. Furnish two percent (but not less than one driver) of solid state drivers/power supplies for each type used on the project.

1.05 DEFINITIONS

A. CU: Coefficient of utilization.

B. HID: High-intensity discharge.

C. HO: High output.

D. IC: Insulation contact.

E. Lamp: The complete light source package, including all associated components (base, pins, filament, outer bulb, solid state components, etc.) that make up a single unit.

F. Light: Radiant energy sensed or seen.

G. Light Fixture: Luminaire.

H. Lumens: Measured light output of lamp (or luminaire if using solid state lamping).

I. Luminaire: A complete lighting unit consisting of a lamp, ballast (or driver) as required together with the parts designed to distribute the light and to position and protect the lamp, as well as the electrical parts required to generate the light. This may include the means to connect to a power supply.

J. Rated Lamp Life:
   1. Incandescent, Fluorescent and HID lamps: The time after which half of the tested sample of lamps have extinguished.
   2. Solid State lamps: L-70, the time after which 70% of the initial lumen output is maintained out of the respective luminaire.

1.06 COORDINATION

A. Review luminaire types with respective ceiling type prior to ordering. Initiate a meeting with the ceiling installer and issue meeting minutes to the A/E. Inform A/E where mounting method conflict occurs.

B. Review luminaire types with location of building insulation prior to ordering. Initiate a meeting with the insulation installer and issue meeting minutes to the A/E. Inform A/E where non-IC rated luminaires are in conflict with the building insulation.

C. Review luminaire types with final millwork shop drawings. Initiate a meeting with the casework installer and issue meeting minutes to the A/E. Verify luminaires will fit where specified in or adjacent millwork prior to rough-in.

D. Coordinate layout and installation of luminaires and associated support methods with all trades.

E. Facilitate coordination meetings once a month (throughout construction) with the general contractor, ceiling installer, sprinkler installer, HVAC installer, plumber, telecommunications installer and all other applicable trades. Shop drawings shall be adjusted accordingly and resubmitted for A/E review and approval. Log shall be kept on site with meeting dates and meeting minutes.

1.07 WARRANTY

A. Comply with requirements in Division 01 and Section 260500 – Warranty.

B. Warranty period as indicated in Section 260500 shall establish minimum requirement, unless otherwise noted.

C. Occupancy-Vacancy Sensors: 5 years.

D. Solid State Lamps and Drivers: 5 years.

E. Generator Transfer Device: 5 years.

PART 2 PRODUCTS

2.01 LUMINAIRES

A. Housing: Metal parts shall be free from burrs, sharp corners and edges. Sheet metal components shall be formed and shall not warp or sag. Luminaires shall be free of light leaks while also providing the required ventilation so as not to degrade the rated photometric performance and rated life of lamps and/or ballasts. Adjustable luminaires shall utilize positive locking devices to set aiming angle; luminaire shall be able to be relamped without affecting aiming angle.

B. Lenses: Where utilized, acrylic plastic shall be 100% virgin acrylic, highly resistant to yellowing and other changes due to aging, exposure to heat and ultraviolet radiation. Minimum thickness of 0.125 inches.

C. Hardware: Finish ferrous mounting hardware and accessories to prevent corrosion and/or discoloration to any and all adjacent materials. Hardware for steel or aluminum luminaires shall be cadmium, or approved, plated. Hardware for stainless steel luminaires shall be stainless steel. Hardware for bronze luminaires shall be stainless steel or bronze.

D. Sockets: Linear fluorescent lamp sockets shall be 4-position positive stop lamp-lock style with knife-edge contacts. HID sockets shall be porcelain for mogul or medium base lamps, pulse rated as required; sockets shall be keyed for all position oriented lamps.

E. Reflecting Surfaces: The following minimum reflectance values shall be met:
   1. White Surfaces: 85%.
   2. Specular Surfaces: 90%.
   3. Anodized Aluminum Surfaces: 93%.

F. Latches: Latches for luminaire doors/louvers, where applicable, shall be spring type and shall operate freely and easily without excessive force.

G. Wiring
   1. Cords/cables between luminaire components shall have a minimum temperature rating of 105°C.
   2. Cords/cables shall be fitted with appropriate strain relief connectors and/or weathertight entries, where required by application.
   3. No internal wiring shall be visible from normal viewing angles.
   4. Cords/cables to pendant luminaires shall match color of respective canopy.
   5. Internal and/or factory wiring shall be a minimum size of 18 AWG.

H. Installed Where Subject to Damage: Where luminaires are installed subject to physical damage and contain metal halide lamping, the luminaires shall consist of means of protection where the lamp is completely enclosed by glass or plastic/acrylic. If the lamp breaks, the glass shards shall not escape the luminaire and the lamp shall not emit ultraviolet light outside the luminaire.

I. Solid State LED luminaires shall be on at least one of the following (or be pre-approved by the A/E):
   1. U.S. Department of Energy Energy Star Qualified Luminaires Product List.
   2. Designlights Consortium Qualified Products List (where applicable category exists) or Lighting Design Lab LED Qualified Luminaire and Tubular LED Lamp List.

2.02 LAMPS

A. Refer to Luminaire (Light Fixture) Schedule for additional information.

B. Notify and send A/E manufacturer's recommendations for lamp/ballast combination if different from products specified.

C. Solid State:
   1. LED:
      a. Manufacturers:
         1) Minimum of 5 year history of producing and/or installing LEDs in North America.

2) Philips/Lumileds, Osram/Sylvania, General Electric, Cree, Nichia, Samsung, or approved.

b. Must be on U.S. Department of Energy Energy Star Qualified Lamps Product List.

c. Must be on the Lighting Design Lab's LED Qualified Lamp List.

d. Replaceable modules shall be designed to Zhaga Consortium standards.

e. 4,000 K CCT, unless otherwise noted.

f. Minimum CRI of 85.

g. Lamps shall not use any energy when 'off'.

h. CCT throughout life of lamp shall be within +/- 200 K of respective specified value.

2. Organic LED lamps are not allowed.

2.03 DRIVERS

A. Refer to Luminaire (Light Fixture) Schedule for additional information.

B. Notify and send A/E manufacturer's recommendations for lamp/ballast combination if different from products specified.

C. Quantities: For continuous linear light fixtures provide quantity of ballasts/drivers required to support the circuiting and control shown on the contract documents.

1. Daylight zones: Provide drivers for control within daylight zones for linear fixtures that are mounted in any portion of a daylight zone. If 50% or more of a control length is in a daylight zone it shall be controlled within that zone.
2. For linear lengths that cross primary/secondary zones control with the more stringent daylight zone.
3. Control Length: Maximum eight foot, minimum four foot.

D. Solid State Drivers/Power Supplies:

1. Manufacturers:
   a. Minimum of 5-year history of producing and/or installing drivers in North America.
   b. Philips/Advance, Osram Sylvania, General Electric, Universal, Thomas Research, or approved.
2. When not in the luminaire, the housing shall be plenum rated.
3. Poke-in wire trap connectors or integral leads color coded per ANSI C82.11.
4. Withstand +/- 10% voltage fluctuation with no compromise of performance or life cycle.
5. +/- 5% output across published load range.
6. 120-277 Volt rating.
7. PF greater than 0.9, at specified voltage.
8. Minimum efficiency of 70% at rated full load.
9. Maximum case temperature rating of 70°C.
10. THD less than 20%.
11. Class A sound rating.
12. Minimum operating temperature of -20°F.
13. Shall tolerate sustained open circuit and short circuit output conditions without damage and without need for external overcurrent protection.
14. No PCB allowed.
15. Comply with ANSI/IEEE C62.41.1 & C62.41.2, Category A for transient protection.
16. Dimmable, as specified in the Luminaire (Light Fixture) Schedule.

2.04 EGRESS

A. UL 924 Listed.

B. Transfer Devices Used in Conjunction with Generators or Central Inverters: Mounted integral with light fixture by manufacturer.
   1. Manufacturers: Philips/Bodine, Iota Engineering, or approved.
   2. Full light output from luminaire in either mode.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory. Work that requires modification due to unsatisfactory conditions, deemed by the A/E, shall be corrected and completed to the satisfaction of the A/E at no additional cost to the contract.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Temporary Lighting for Construction Use: Contractor shall provide lighting used during the construction period for construction tasks. Permanent luminaires that are part of the project may not be utilized for this use.

C. Temporary Lighting required as part of Project Phasing: As approved by A/E, permanent luminaires may be used for temporary lighting means. Install and energize the minimum number of luminaires necessary for the task. When construction is sufficiently complete, remove the temporarily installed luminaires in a neat and workmanlike manner, dissemble, clean thoroughly, replace lamp(s) and ballast(s) and install in permanent location per the contract documents. Permanently installed luminaires deemed by the A/E to be damaged shall be replaced at no additional cost.

D. Remote Mounting of Ballasts (where indicated on the drawings and/or approved by the A/E): Distance between the remote ballast and respective luminaire shall not exceed distance recommended by the ballast manufacturer. If recommended distance conflicts with the drawings, notify the A/E prior to rough-in.

3.04 INTERIOR LUMINAIRE INSTALLATION

A. Install luminaires at locations and heights as indicated on the Drawings, in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NESC, NECA's "Standards of Installation", NEMA standards, and recognized industry practices to ensure that luminaires fulfill requirements. Luminaires shall be installed exactly level, secure and plumb with respective building lines. Wall mount and ceiling mount luminaires shall be securely and tightly attached to their respective mounting surface. Lay-in luminaires shall sit flush with grid ceiling system, doors shall swing completely open in the designed direction.

B. Luminaire Supports:
   1. General: Comply with IBC and NEC (including all local amendments) as interpreted by AHJ for luminaires mounted in suspended ceilings. Lay-in and pendant luminaires shall not be supported by lay-in suspended grid ceiling system and must be attached to structure.
   2. Support Requirements:
      a. Include flexible ball joint hangers for pendant and stem hung luminaires at designated points of support.
      b. Equip hooks used to hang luminaires with safety latches. Include supports, brackets, clips, screws and miscellaneous items for mounting luminaires.
      c. Include locking catches, screws, safety chain(s) or safety cable(s) for detachable luminaire parts, luminous ceiling accessories, louvers, diffusers, lenses and reflectors.
   3. Seismic Restraints:
      a. For Luminaires Weighing Less than 10 Pounds: Install (1) slack No. 12 gauge hanger wire from luminaire to structure above.
      b. For Luminaires Weighing 10 to 56 Pounds: Install (2) independent slack No. 12 gauge hanger wires from opposite corners of luminaire to structure above.
      c. For Luminaires Weighing More than 56 Pounds: Support directly from the structure above by hangers approved by the AHJ. Comply with requirements in Section 260548 for seismic restraints.
      d. For Pendant Hung Luminaires: Support directly from structure with No. 9 gauge hanger wire or alternate support without using ceiling suspension system for direct support approved by the AHJ. Comply with requirements in Section 260548 for seismic restraints.

C. Fire Rated Assemblies: Provide gypsum board protection acceptable to the AHJ to ensure fire rating of ceiling or wall in which luminaires are installed. Maintain manufacturer's recommended ventilation requirements.

D. Provide backing in wall cavity to reinforce support for wall mounted luminaires.

E. Luminaire Contact with Building Insulation: When building insulation is installed at a location where contact with luminaires is unavoidable, IC-Rated luminaires shall be utilized. Where insulation is present and an approved IC-Rated luminaire is not available, provide a gypsum board assembly around the luminaire, maintaining all recommended ventilation requirements, to separate luminaire from adjacent insulation.

F. Protect installed luminaires from damage during construction period through date of substantial completion. Damaged luminaires, including associated components, shall be replaced in their entirety.

3.05 FIELD QUALITY CONTROL

A. Upon completion of installation of luminaires and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Repair malfunctioning units on site, then retest to demonstrate compliance. If not possible to repair on site, remove and provide new units and retest. Include copy of test reports in the Operation and Maintenance Manual.

B. Clean luminaires in their entirety of dirt and debris upon completion of installation, including but not limited to housing, lens(es), lamp(s) and louver(s) within (7) days of substantial completion.

C. At Substantial Completion, remove and provide new lamps in interior and exterior luminaires which are observed to be noticeably dimmed due to Contractor's use and testing, as judged by the A/E.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Work includes the following:
   1. Structured Cabling System supporting various low-voltage systems
   2. Telecommunications Rooms and Spaces
   3. Grounding and Bonding Infrastructure
   4. Manufacturer Certification

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and 260500 sections apply to Work in this section.

1.02 RELATED SECTIONS

A. Related Sections
   1. 260500 – General Electrical Provisions
   2. 260510 – Basic Electrical Materials and Methods

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. Installation Standards: Comply with following standards for cable and equipment installations. Publications shall be latest issue and addenda:
      a. NEC, National Electric Code.
      b. NESC, National Electric Safety Code.
      c. TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises.
      d. TIA-568-C.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements.
      e. TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
      f. TIA-569-D, Commercial Building Standard for Telecommunications Pathways and Spaces.
      g. TIA-606-B, Administration Standard for the Telecommunications Infrastructure of Commercial Building.
      h. TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises.
      i. TIA-862-B, Structured Cabling Infrastructure for Intelligent Building Systems.
      j. IEEE 802.3-2000. Ethernet Standard.
      k. BICSI 001, Information Transport Systems Design Standard for K-12 Educational Institutions.
      l. BICSI Information Transport Systems Installation Methods Manual.
      m. BICSI Telecommunications Distribution Methods Manual.
   2. Contractor shall have read the above documents and shall be familiar with the requirements that pertain to this installation. The documents may be obtained from:
      a. Global Engineering Documents, 15 Inverness Way East, Englewood, CO, 80112-5776, 800-854-7179, http://global.ihs.com/
      b. BICSI, 8610 Hidden River Parkway, Tampa, FL, 33637, 800-242-7405, www.bicsi.org

3. Materials:
    a. UL listed and labeled. Install label to be visible.
    b. Equipment: Regularly catalogued items of manufacturer and supplied as complete unit in accordance with manufacturer's standard specifications with optional items required for proper installation unless otherwise noted in this section.
    c. Telecommunications connectivity and cabling independently tested to meet current TIA standards.

C. Qualifications:
1. Contractor performing work specified in this section is required to have special skills obtained by education, experience, or both.
2. Contractors bidding work specified herein shall have a minimum of seven years of experience in the construction, testing, and servicing of systems of the type and magnitude specified in this section.
3. Contractor shall be a certified installer of the telecommunications system and pre-qualified by the manufacturer for the purpose of offering the Applications Assurance warranty at the time of bid.
4. Contractor shall have direct access to the tools and test equipment required to complete the Work at the time of bid.
5. Project manager (in office) and superintendent (field) shall have 5 years of experience at project manager and superintendent levels, respectively, on completed telecommunications projects of like magnitude and complexity as to this project. Project manager shall be certified as a Registered Communications Distribution Designer (RCDD) through Building Industry Consulting Service International (BICSI).
    a. RCDD shall be a direct employee of the company bidding on said Work.
6. Field technicians who will work independently at any given time during the project on the structured cabling system shall have a minimum of 3 years' experience on completed telecommunications projects of like magnitude and complexity as to this project. Field technicians working at job site shall have completed a copper technician installation training class conducted by the warranting manufacturer or BICSI.
7. Field technicians who will work independently at any given time during the project on the optical fiber systems shall have a minimum of 3 years' experience on completed telecommunications projects of like magnitude and complexity as to this project. Field technicians working at the job site shall have completed an optical fiber technician installation training class conducted by the warranting manufacturer or BICSI.

1.04 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.
1. Submit complete at one time. Partial product submittals are not acceptable and will be returned unreviewed.

B. Pre-Construction Submittal:
1. Product Data
    a. Submit with data arranged under basic categories, such as, certifications, personnel training, manufacturer warranty, products, test equipment and calibration, and similar items. Include index with the submittals.
    b. Organize by specification infrastructure component sections described in Part 1 and Part 2 of this section.
    c. Submit Product Data information sheets for coordination with item and model number.

d. Where more than one product is indicated on a page, mark product with arrow or by other means to identify exact product or products being submitted by specific part number.
e. Submit network test equipment proof of calibration by manufacturer.
f. Submit resumes and certifications of technicians and project manager who will support this project. Certifications shall include:
    1) Manufacturer's certification to provide warranty
    2) RCDD certification
    3) Copper and optical fiber installation certification
    4) Approved manufacturer classes satisfactorily completed

C. Test Reports:
1. Prepare test reports and submit to the Owner's Representative an electronic copy of the detailed test results, including overall test summary report.
2. Include a copy of the detailed test reports on CD-ROM in each Operation and Maintenance Manual.
3. Include a hard copy of the summary test sheets in each Operation and Maintenance Manual.
4. Submit electronic copies in PDF and LinkWare software formats, including LinkWare reader software.

D. Record Drawings:
1. Keep complete set of telecommunications drawings in job-site office updated within 3 days to show actual installation of cabling and equipment during construction.
2. Use of this set of drawings for recording as-built conditions.
3. Indicate where material, equipment, and system component are installed differently from that indicated on the Contract Drawings, clearly and neatly using ink or indelible pencil in color red during construction.
4. Prepare electronic set of Record Drawings, incorporating changes during construction. Submit Record Drawings to the Owner's Representative for review and acceptance.
5. Submit Record Drawings using latest version of AutoCAD software or as approved by the Owner, and in PDF format. Request (from architect) final architectural background drawing files that incorporate floor plan and program spaces numbering modifications.
6. AutoCAD drawings shall be e-transmitted to include backgrounds, title blocks and other associated files.
7. Submit electronic copy of Record Drawings in full-size PDF and AutoCAD format, on CD-ROM.

E. Project Closeout:
1. Submit closeout documentation to the Owner's Representative and Architect under provisions of Division 01, Section 260500 and this section.
2. Provide project closeout documentation including but not limited to; test result documentation, Record Drawings, manufacturer warranty certificates and Operation and Maintenance manuals.

1.05 DEFINITIONS

Accessible ceiling: An area above acoustical ceiling tiles/grid (or lay-in type ceilings) with a readily accessible space. Gypboard ceilings with access hatches and open to structure spaces shall not be considered accessible ceilings

Administration: Methodology defining the documentation requirements of a cabling system and its containment, the labeling of functional elements, and the process by which moves, additions, and changes are recorded

Bonding: Permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed

Cable: An assembly of one or more insulated conductors or optical fibers within an enveloping sheath

Cable run: Length of installed media, which may include other components along its path

Cabling: System of cables, cords, and connecting hardware

Channel: End-to-end transmission path between 2 points at which application-specific equipment is connected including test cords and patch cords for a maximum total distance of 328 feet (100 meters)

Connecting hardware: Device, or combination of devices, used to connect cables or cable elements

Consolidation point: Location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways

Cross-connection: Connection scheme between cabling runs, subsystems, and equipment using patch cords or jumpers that attach to connecting hardware on each end

Demarcation point: Point where operational control or ownership changes

Equipment room: Environmentally controlled centralized space for telecommunications equipment that usually houses a main or intermediate cross-connect

Ground: Conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of earth

Horizontal cabling: Distribution media that connects the telecommunications outlet/connector at the work area and the first piece of connecting hardware in the horizontal cross-connect

Horizontal cross-connect: Group of connectors that allows equipment and backbone cabling to be cross-connected with patch cords or jumpers

Infrastructure (telecommunications): Collection of those telecommunications components, excluding equipment, that together provides basic support for the distribution of information within a building or campus

Local area network (LAN): Standard industry term for a network installation that serves a relatively small area (for example, structured cabling installation serving a building)

Main cross-connect: Cross-connect normally located in the (main) equipment room for cross-connection and interconnection of entrance cables, first-level backbone cables, and equipment cables

Metropolitan area network (MAN): Data communications network that covers an area larger than a campus area and smaller than a wide area network

Modular jack: Female telecommunications connector that may be keyed or unkeyed and may have 6 or 8 contact positions

Outlet/connector (telecommunications): Connecting device in the work area on which a horizontal cable or outlet cable terminates

Patch cord: Length of cable with connectors on both ends used to join telecommunications circuits/links at the cross-connect

Patch panel: Connecting hardware system that facilitates cable terminations and cabling administration using patch cords

Pathway: Sequence of connections that provides connectivity between devices on a network or between networks on an internetwork; the vertical and horizontal route of the telecommunications cable; a facility for the placement of telecommunications cabling

Permanent link: Test configuration for link excluding test cords and patch cords for maximum total distance of 295 feet (90 meters)

Plenum: Compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system

Telecommunications Room: Enclosed architectural space for housing telecommunications equipment, cable terminations, and cross-connect cabling

Storage Area Network (SAN): Specialized high-speed network dedicated to the transport of data between storage devices and servers

Star topology: Network topology in which services are distributed from or through a central point

Telecommunications: Transmission, emission, and reception of signs, signals, writings, images, and sounds, that is information of any nature by cable, radio, optical, or other electromagnetic systems

Unshielded twisted pair (UTP): Cable made up of one or more pairs of twisted copper conductors with no metallic shielding; the entire assembly is covered with an insulating sheath (cable jacket)

Wireless access point: Stand-alone hardware device or computer wireless adapter with software that acts as a wireless communication hub for users of wireless devices to connect with each other and to bridge those devices to the cabled portion of the network

Wide area network (WAN): Data communications system that uses telecommunications circuits to link LANs that are distributed over large geographic distances

Wireless local area network (WLAN): Data communications system that uses using radio frequency technology, such networks transmit and receive data over the air, minimizing the need for wired connections; they combine data connectivity with user mobility

Work area (workstation): Building space where occupants interact with telecommunications terminal equipment

Work area cable (cord): Cable connecting the telecommunications outlet/connector to the terminal equipment

1.06 PRE-CONSTRUCTION MEETINGS

A. Telecommunications subcontractor shall attend the pre-construction meeting as required by the Contractor or the Owner's Representative.

B. Provide a schedule, indicating installation tasks, time duration for each task and coordination items to be discussed 5 days prior to the meeting, to the Contractor and to the Owner's Representative. Include milestone dates for network equipment installation and patch cord installation durations.

1.07 MANUFACTURER CERTIFICATION

A. Structured cabling system shall be covered by an Extended Product and Application Assurance Warranty.
   1. Warranty shall cover passive telecommunications infrastructure copper and optical fiber connectivity and cabling products and performance from the date of installation registration, and will support existing or future applications.

2. Approved manufacturer solution partner and warranty is:
   a. Berk-Tek/ Leviton Technologies – Limited Lifetime warranty or equal
3. Installation practices shall follow the installation guidelines and procedures specified in the manufacturer certified installer training course and current TIA standards.
4. Submit closeout documentation in accordance with the manufacturer warranty requirements to comply for acceptance of warranty.

B. Provide the original hard copy certificate for the Application Assurance Warranty to the Owner.

1.08 MATERIAL PROVISIONS

A. Deliver materials to the Owner under provisions of this section.

B. Contractor shall be responsible to provide a material transmittal for all materials being provided to the Owner as described herein and that are not permanently installed. Transmittal shall be signed by the Owner receiving the materials. Transmittal shall be included as part of the O&M manuals.

PART 2 PRODUCTS

2.01 COPPER HORIZONTAL CABLING

A. Category 6 UTP cabling for interior spaces:
1. Horizontal cables shall be constructed from 23 AWG insulated solid bare copper conductors formed into four individually twisted pairs with a crossfiller center spline.
2. Conductors shall have an impedance of 100Ω ±10% / 100m.
3. Cables shall meet the most current technical characteristics of TIA-568-C standard.
   a. Wire map
   b. Length
   c. Insertion loss (Attenuation) 32.6dB/100m @ 250MHz
   d. Near-end crosstalk (NEXT) loss 43.3dB/100m @ 250MHz
   e. Attenuation to crosstalk ratio far-end (ACRF) 24.8dB/100m @ 250 MHz
   f. Power sum Attenuation to crosstalk ration far-end (PSACRF) 21.8dB/100m @ 250MHz
   g. Power sum-near-end crosstalk (PS-NEXT) 41.3dB/100m @ 250MHz
   h. Return loss (RL) 20.5dB/100m @ 250MHz
   i. Propagation delay (PD) (CMP) 72% nom, (CMR) 68% nom
   j. Delay skew (DS) 45ns/100m max
   k. Balance (LCL/TCL) 27.0dB/100m @ 200MHz
   l. Balance (EL-TCTL) 9.0dB/100m @ 200MHz
4. Cables shall be NFPA 262 CMP (plenum) rated as specified herein, unless otherwise noted. Cable diameter shall not exceed 0.23 inches.
   a. Manufacturer Berk-Tek LANmark-1000 series:
      1) Blue plenum rated, Part No. 10032094 or equal

2.02 TELECOMMUNICATIONS WORKSTATION DEVICES

A. Category 6 Modules:
   1. 8-Position 8-Conductor modules shall be Category 6, dual reactance technology, non-keyed, universal T568A/B pin configuration standard and used to terminate Category 6 UTP cables as specified herein. Module shall be high impact plastic housing, flame retardant UL 94V-O, modular contacts shall be beryllium copper, nickel plating under 50 micro-inches gold plating in contact area. IDC contacts shall be phosphor bronze, nickel under plating with tin lead over plate serving 22 through 24 AWG.
      a. Manufacturer Leviton:
         1) Category 6 module:
            a) Ivory, Part No. 61110-RI6 or equal
         2) Blank module in package of 10:
            a) Ivory, Part No. 41084-BI or equal

B. Faceplates:
   1. Faceplate shall be thermoplastic or stainless steel manufactured to hold 8P8C modules with recessed designation strips with clear plastic covers in accordance with the TIA-606-B labeling standard.
      a. Manufacturer Leviton:
         1) 4-port stainless steel, Part No. 43080-1L4 or equal

2.03 DIRECT CONNECT AND CAMERA CONNECTIVITY

~~A.~~ Direct Connect Connectivity and Terminations:
   1. 8P8C Modular Plugs
      a. Pre-approved Category 6 8-position, 8-conductor 8P8C plugs shall be provided based on the warranting manufacturer for the direct attach termination to solid conductor Category 6 cabling.
      b. 8P8C plugs shall be compatible to be terminated on both Category 6 and Augmented Category 6 cabling.
      c. 8P8C plugs shall be field terminated with manufacturer approved termination tool. No other termination tools shall be authorized for the termination of these direct attach terminations.
      d. Plugs with a plastic boot shall be plenum rated when used in an air-plenum environment.
      e. Adhere to manufacturer’s plug installation guidelines and testing procedures to ensure proper performance and signal transmission.
         1) Category 6 8P8C plug approved manufacturers:
            a) Bel Stewart, Part No. SS-39100-021
            b) Sentinel, Part No. 111-08080054L34
            c) Allen Tel, Part No. AT8X8RCSC-24
         2) 8P8C termination tool approved manufacturers:
            a) Bel Stewart, Part No. 2990003-01
            b) Sentinel, tool & die set, Part No. 9000015 & 900216
            c) Allen Tel, Part No. AT568 or AT680

2.04 OPEN CABLING SUPPORTS

A. Accessories and mounting hardware shall be provided for securing supports to structure for a complete and working installation of open cabling supports. Supports shall comply with TIA requirements for structured cabling systems and pathway supports. Follow manufacturer's recommendations for quantity of cables supported.

B. Hook & Loop Fasteners:
   1. Hook and loop fastener rolls shall be offered in 15 and 75-foot lengths and be 0.5-inch in width. Shear strength; for plenum rated product shall be 29 PSI and non-plenum rated product shall be 23 PSI. Hook and loop fasteners installed in plenum air spaces shall be UL Listed (plenum) and be in the color maroon.
      a. Manufacturer Leviton or equal:
         1) Non-plenum 15' roll, Part No. 43115-15
         2) Non-plenum 75' roll, Part No. 43115-75
         3) Plenum 15' roll, Part No. 43115-15P
         4) Plenum 75' roll, Part No. 43115-75P

C. J-Hooks:
   1. J-hooks shall have a Galvanized finish with rounded edges for smoother cable pull and greater corrosion resistance.
      a. Manufacturer Erico Caddy:
         1) 1" Dia., Part No. CAT16HP
         2) 1-5/16" Dia., Part No. CAT21HP
         3) 2" Dia., Part No. CAT32HP

D. Adjustable Cable Support:
   1. Adjustable cable supports shall be of steel and polyethylene, plenum rated, with unlocking and locking bar allowing additional cables to be added easily after installation.
      a. Manufacturer Erico Caddy, Part No. CAT425

2.05 MATERIAL PROVISIONS

A. Materials shall be provided to the Owner as specified herein. Deliver to the Owner Representative 21 days prior to Substantial Completion. Include a signed transmittal to the Owner or Owner's Representative for each type of patch cord, quantity, length, and color provided as part of the Final Acceptance.
   1. Copper Patch Cords

      a. Category 6 Patch Cords
         1) Patch cords shall be constructed from Category 6 4-pair 24 AWG, stranded patch cable material.
         2) Patch cord cable assembly shall be UL→ listed and meet FCC Part 65 plug and termination.

Item	Manufacturer	Part Number	Qty.	Length	Color	Description
1	Ortronics	OR-MC603-06	4	3'-0"	Blue	*Data*
2	Ortronics	OR-MC605-06	4	5'-0"	Blue	*Data*

PART 3 EXECUTION

3.01 GENERAL

A. Include labor, materials, tools, equipment and services for installation as indicated on the Contract Documents.

B. Coordinate Work with other trades for complete and operational system.

C. Include supplementary and miscellaneous items, appurtenances, and devices incidental to and necessary for sound, secure, and complete installation, whether or not specifically indicated in the Contract Documents.

D. Provide suitable barriers and take any other safety precautions required by applicable codes.

E. Work area shall be kept free from debris of all types and remove all rubbish resulting from their work on the premises. Upon completion, vacuum and clean room floors, equipment racks, enclosures and cable management where work has been performed.

F. Contractor shall be responsible for any building repairs made necessary by their work or caused by negligence of their employees. No cutting, notching, drilling or altering of any kind shall be done to the building without first obtaining permission from the Owner.

G. Owner may have other contracts in connection with this work for the installation of software and equipment. Contractor shall provide other Trade Contractors reasonable opportunity for the introduction and execution of their work and shall properly coordinate other trade's work with theirs as required.

H. Provide cables, devices and equipment racking systems as indicated on the Contract Drawings.

3.02 OPEN CABLING SUPPORT INSTALLATION

A. Cabling shall be run exposed as "open cabling" in ceiling spaces and ceiling plenums, unless otherwise noted.

B. Provide all hanger supports and cable supports for cabling specified in this section. All support structures shall adhere to the requirements in the National Electrical Code.

C. Cabling supports shall be spaced no further than 4'-0" apart.

D. Cabling bundles shall not sag a maximum of two inches from the bottom of the cable support.

E. Provide all additional cable management products as required to protect exposed cabling and complete the installation of cabling in a neat professional manner.

F. Floor penetrations shall be at columns, exterior walls unless otherwise specified.

G. Cabling supports shall be installed on their own support system. The use of ceiling grid supports shall be prohibited.

H. Do not support cables from ductwork, sprinkler piping, water piping, waste piping, conduit or other system supports. Cabling shall never come in physical contact with these mechanical, fire protection and electrical systems and raceways.

I. Cabling bundles and supports changing pathway direction shall maintain proper bend radius as to not impact the physical jacket construction of the cabling. Cabling that becomes damaged during this transition shall be replaced in its entirety.

J. Follow manufacturer's recommendations for quantity of cables supported in J-hooks and adjustable cable supports.

K. Installers shall observe the applicable requirements and recommended good practices contained within TIA-568-C standard for cabling installation requirements.

3.03 CABLING INSTALLATION

A. Telecommunications devices shall be connected to the horizontal cross-connect in a telecommunications room with horizontal cabling installed in star topology.

B. Horizontal cabling shall be installed in continuous runs from the telecommunications rooms to telecommunications device locations. Splices are not permitted.

C. Maximum length of horizontal cables shall be 295 feet (90 m) including all service loops.

D. Cabling shall be installed in accordance with manufacturer's recommendations, including but not limited to maximum tensile loading and maximum bend radius.

E. Cabling shall be organized and identified so as to facilitate locating and handling individual sheaths for maintenance functions.

F. Bundles shall be neatly secured without cinching or stressing the cabling, using hook and loop fasteners in open cabling installations and in the telecommunications room. Hook and loop fasteners shall be loose enough so that the fastener can be easily rotated around the cabling bundle and does not impact the physical construction of the cabling.

G. Provide machine typed label on both ends of the horizontal cabling jacket no more than 4-inches from each termination point.

H. Great care shall be taken to protect all cabling from physical damage beneath floors, above ceilings or elsewhere. Cabling shall not be exposed to any forces or handling factors that will degrade performance, such as crushing, pull stressing, twisting, or damaging sheathing materials. When left unattended, all cabling shall be secured and protected to avoid damage.

I. Hook and loops fasteners shall be utilized in the telecommunications room for all cabling bundles. Tie wraps are prohibited in the telecommunications rooms and spaces.

J. A spare pull string shall be installed at every outlet installed.

K. Horizontal and backbone cabling shall be bundled and routed separately in dedicated cabling supports in a neat and organized fashion for routing from the telecommunications rooms utilizing cable trays and open cabling pathways to the telecommunications devices.

L. Route cabling runs from workstations parallel to building grid lines and directly to open cabling pathways without passing over adjacent office spaces or cubicles.

M. Provide 5 feet of slack in neatly suspended loops above each workstation and 10 feet of slack neatly coiled in the ladder rack or cable tray in the telecommunications room unless indicated otherwise on Contract Drawings. Service loops in the telecommunications room shall not be located above the equipment racks and server enclosures.

N. Cables shall contact only dedicated and properly protected cable accesses and support mechanisms.

O. Telecommunications unshielded twisted pair cabling supported utilizing open cabling methods shall maintain a minimum separation of three inches from fire alarm, intercom/paging, clocks and security cabling. Cabling supports shall maintain increased separation requirements when attaching to the same hanger rod to ensure cabling sag maintains the minimum three inch separation.

P. Maintain the following distances between cabling and other building systems:
   1. One foot from fluorescent lights.
   2. Six feet from motors and transformers.
   3. Three feet from water piping or other mechanical equipment.
   4. One foot from electrical conduits or other electrical equipment.

3.04 CONNECTIVITY AND CABLING INSTALLATION

A. Cabling shall be dressed and terminated in accordance with the cabling installation requirements identified in TIA-568-C, BICSI Telecommunication Cabling Installation Manual, and the manufacturer's documentation.

B. Cabling entering the telecommunications room and routing on the ladder rack or cable tray pathway shall be separated into cabling bundles specific to the patch panel in which it will be terminated to. Cable bundles shall be in increments of 24 cables.

C. Cabling shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the equipment rack, enclosure or backboard.

D. Cabling transitioning from ladder rack or cable tray pathway shall maintain proper bend radius utilizing waterfall device brackets for transitioning vertically down the side rail of an equipment rack or server enclosure as to not impact the physical jacket construction of the cable. Waterfall device brackets shall also be utilized for transitioning cabling to blocks mounted on plywood. Cabling that become damaged during this transition shall be replaced in their entirety.

E. Cables shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support straps. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

F. Installation of 8-position 8-conductor modular jacks into faceplates and attaching of the faceplates to the wall shall ensure that the faceplates are flush. The faceplate shall be secured to the wall but shall not be secured to the wall with such force as to bow the faceplate.

3.05 WORK AREA

A. 4-pair UTP horizontal cabling shall be terminated on an 8-position 8-conductor modular jack or plug at each telecommunications device as indicated on the applicable Contract Drawings.

B. Telecommunications devices shall be provided with 8-position 8-conductor modular jacks or plugs in the quantity as indicated on the applicable Contract Drawings.

3.06 CABLING TERMINATIONS

A. Provide all necessary installation materials, tools and equipment to perform insulation displacement type terminations at all the telecommunications outlets, patch panels and 110 cross-connect blocks.

B. Pairs in each cable shall be terminated on a 110 block, modular patch panel or telecommunications modules in accordance with this specification.

C. Cabling shall be terminated in accordance with the T568B pin configuration standard.

D. Remove only as much of the cable sheath as is necessary to terminate the cabling on the connecting hardware.

E. A maximum of 0.25” of cable pair twists shall be removed from a 4-pair UTP cable. Cabling and terminations exceed these dimensions shall be re-terminated.

F. At the horizontal station patch panel, the cabling shall terminate from the center of the 110 IDC termination.

G. Terminate cabling in accordance with connecting hardware manufacturer’s recommendations. All cabling shall terminate in numerical sequence.

3.07 FIRESTOPPING

A. Firestop systems shall be installed in accordance with the NEC and the manufacturer’s recommendations and shall be accomplished in a manner acceptable to the local fire and building authorities having jurisdiction over this work.

B. Cabling running through rated floors and walls shall be firestopped in accordance with the requirements within this Section.

C. Penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure).

D. Penetrations created by or for the contractor and left unused shall also be sealed as part of the contractor’s scope of work.

E. Firestop putty or pillows shall be used inside conduits and cable trays to provide a re-enterable system allowing telecommunications cables to be easily removed or added in the future. Firestop putty shall not be water soluble.

F. Firestop systems shall be UL Classified to ASTM E814 (UL 1479).

3.08 LABELING

A. General:
   1. Labeling shall be in accordance with TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure.
   2. Labels shall be permanent typewritten labels produced by a labeling machine.
   3. Labels shall be installed on all cabling at each end. Ensure labels are securely fastened.
   4. Labels shall be located within 6 inches of cable termination and placed so they can be easily read.
   5. Font type for each type of label shall be Arial with maximum size font allowed.
   6. Labeling information will be reviewed at the Pre-Construction Meeting.
   7. Labeling shall be completed prior to the Substantial Completion date of the project.

3.09 TESTING

A. Test procedures shall be as prescribed by the TIA, Insulated Cable Engineers Association and the National Electrical Testing Association.

B. Test Equipment:
   1. Network testing equipment shall be a Fluke Networks DSX-5000 Cable Analyzer or equal and shall have a certified calibration from the manufacturer within the past 12 months at the time of testing. Proof of calibration shall be provided with the product submittal. Test equipment shall be utilized to test horizontal and backbone cabling.
   2. Field tester and adapters shall be certified by an independent laboratory as meeting or exceeding current level as defined in TIA-1152 Level IIIe.
   3. 8P8C test plug for the network testing equipment adapters shall be in range of values defined in Annex C with TIA-568-C for Near-end Crosstalk, Far-end Crosstalk and Return Loss.
   4. Test equipment shall support the complete suite of Resistance Unbalanced standards for PoE per IEEE 802.3af, IEEE 802.3at and TIA-568-C.2.
   5. Test equipment shall be able to test up to a 1000 MHz frequency range.
   6. Test equipment shall be ISO 9001 certified.
   7. An electronic copy of the manufacturer's testing procedures shall be kept in the job site office.
   8. Test equipment batteries shall be charged daily and a level of greater than twenty-five percent of capacity shall be maintained during the testing.
   9. Test equipment shall be calibrated daily before the start of testing.

C. Horizontal Cabling:
   1. Horizontal cabling shall be certified to meet or exceed the permanent link performance specifications for Category 6 horizontal cabling tested with a frequency range from 1MHz to 250 MHZ as defined in TIA-568-C.
   2. Certifications shall include the following parameters for each pair of each cable installed:
      a. Building identification
      b. Cable identification
      c. Date of test
      d. Test equipment manufacturer and model number
      e. Wire map
         1) Continuity to the remote end.
         2) Shorts between any two or more conductors
         3) Reversed pairs
         4) Split pairs
         5) Transposed pairs
         6) Any other miswiring
      f. Length
      g. Near-end crosstalk (NEXT)
      h. Attenuation to crosstalk ration far-end (ACRF)
      i. Power sum Attenuation to crosstalk ration far-end (PSACRF)
      j. Power sum-near-end crosstalk (PS-NEXT)
      k. Return loss (RL)
      l. Propagation delay (PD)
      m. Delay skew (DS)
   3. Horizontal cabling shall be tested using a Permanent Link configuration as defined in TIA-568-C.
   4. Test reports with an asterisk (*) or fails, shall be documented identifying the reason for the test failure and a corrective action plan developed.
   5. After corrective action has been completed, the permanent link shall be retested.

6. It is the Telecommunications Contractor's responsibility to ensure 100 percent of the network horizontal cabling system links pass all tests.
7. Test results shall be organized by building identification and cable identification number. The test results shall contain the date and time of when each test was saved in the memory of the tester. The test results shall be recorded on a CD-ROM in both PDF and LinkWare software formats.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Design, furnish, install, and connect analog addressable, intelligent fire alarm and detection system required to form a complete coordinated system ready for operation. It shall include, but not be limited to, initiating devices, alarm notification appliances, control panels, annunciators, auxiliary control devices, power supplies, batteries, wiring and ancillary devices as shown on the Contract Drawings, as specified herein or as required to meet AHJ requirements. Contract Drawings and Specifications indicate minimum system requirements. This is a bidder-designed system and it is the responsibility of the fire alarm system vendor to provide an AHJ approved system and design.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Authorities Having Jurisdiction (AHJs):
   1. Lewis County Fire District.
   2. Washington State Fire Marshall.

C. Codes and Standards:
   1. NFPA 70, National Electrical Code (NEC).
   2. NFPA 72, National Fire Alarm Code.
   3. UL 268, Standard for Smoke Detectors for Fire Alarm Signaling Systems.
   4. UL 864, Control Units and Accessories for Fire Alarm Systems.
   5. UL 217, Standard for Smoke Alarms.
   6. FM Global.

D. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Components and systems UL listed and labeled for fire alarm systems and fire alarm and detection systems and accessories and FM approved. Comply with applicable State and local requirements.

E. Comply with applicable provisions of current NFPA 72, local building codes, and requirements of AHJs.

F. Permits and Fees:
   1. Arrange for inspections and pay for all required licenses, permits, inspections, plan review fees and any other fees.
   2. Submit complete set of fire alarm system submittals to AHJ for approval.

G. Fire Alarm and Detection System Installer Requirements:
   1. The installer shall be an authorized manufacturer’s agent staffed with factory-trained and certified sales and service technicians. The installer shall have been the designated manufacturer’s representative in the local market for a minimum of five (5) years.
   2. The local office of the installer shall be UL listed under the UUJS or UUFX category as a qualified fire alarm system provider.

3. The fire alarm system installer shall coordinate the installation of the fire alarm system including the preparation of shop drawings and submittals to the Authority Having Jurisdiction.
4. System design and preparation of shop drawings shall be by factory-trained personnel with the following qualifications: NICET-certified fire-alarm technician, Level II minimum.
5. System installation shall be by factory-trained personnel with the following qualifications: NICET certified fire alarm technician, Level II minimum.
6. System commissioning and testing shall be by factory-trained personnel with the following qualifications: NICET certified fire alarm technician, Level II minimum.
7. Contractor's factory trained technical representative shall respond to job site within 24 hour period for emergencies relating to system.
8. Emergency response is defined as having a technician actively troubleshoot and correct problem at job site.

1.03 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Installer Qualifications.

C. Existing Fire Alarm Programming: Prior to submitting design, download and print out existing fire alarm system program and sequence of operations functionality. Utilize this information for preparation of new system submittals. Submit a hard copy.

D. Sequence of Operation Matrix: Provide a sequence of operation matrix which includes all trouble and alarm conditions monitored by the system. The matrix shall be included in the shop drawing set. Provide written sequence of operation that describes the interlocks between the Fire Alarm system and all other building systems (Fire sprinkler, HVAC, Access Control, etc.).

E. Product Data: Submit manufacturer's technical product data for fire alarm and detection systems components including, but not limited to, roughing-in diagrams and instructions for installation, operation, and maintenance, suitable for inclusion in the Maintenance and Operation Manuals. Include riser and wiring diagrams for panel and system components.

F. Shop Drawings: Indicate equipment and device locations and connecting wiring of entire fire alarm and detection system. Include layout wiring and riser diagrams, point-to-point diagrams, and floor plans with indicating devices, raceways and wiring routing, including device addresses and strobe candela ratings.

G. Details. CAD based schedules to include:
   1. Battery Calculations.
   2. Notification Appliance Circuit Calculations and Loads.
   3. Strobe Circuit Voltage Drops.
   4. Notification Appliance Circuit Schedules.
   5. Symbol Legend and Wiring Code (per manufacturer's requirements).
   6. Sequence of Operation Matrix.
   7. I/O Point and Relay Schedules.
   8. Typical Wiring Diagrams indicating connections between panel modules and field devices and auxiliary interfaces (i.e. elevator controls, fire doors, etc.).

H. Acceptance Test Procedure: Submit a written Acceptance Test Procedure (ATP), approved by the AHJ, to Engineer at least thirty days prior to scheduled testing. The ATP shall include step-by-step procedures for performance testing every fire alarm device and system output to demonstrate functionality in accordance with specification requirements.

I. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

J. Obtain from each AHJ written certification that the permanent installation has been inspected and that it complies with AHJs' published regulations and requirements. Submit prior to Substantial Completion.

K. Operation and Maintenance Data: Comply with requirements in Section 260500. In addition, include the following:
   1. Prepare complete, simple, understandable, step-by-step, testing instructions with recommended and required testing frequency of equipment with methods for testing equipment. Include trouble-shooting manual.
   2. Prepare complete, easy-to-read, understandable maintenance instructions including the following information:
      a. Instruction on replacing components of system including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.
      b. List of equipment and components with address and phone number of both manufacturer and local supplier of each item.
   3. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
   4. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
   5. Record copy of site-specific software.
   6. Submit minimum one week prior to system training.

1.04 SYSTEM DESIGN CRITERIA (BIDDER DESIGN)

A. Design, furnish, and install complete operable fire alarm and detection systems in accordance with the latest adopted editions of IBC, IFC, NFPA 72, and applicable city, county, and state laws, codes, and standards.

B. The Contractor's scope of work shall include but not limited to the following:
   1. Complete fire alarm system based on the available architectural, civil, structural, mechanical and electrical drawings. Devices shown on drawings do not reflect complete system. Provide additional devices, conduit, wire and programming for a complete and operable system as required by AHJ.
   2. Wiring systems associated with fire alarm system.
   3. Providing additional smoke detectors, heat detectors, manual alarm stations, horns, visual evacuation alarm devices, voice evacuation alarm devices, bells, door closers and holder controls, panels, power supplies, and control graphic annunciators associated with fire alarm system.
   4. Providing auxiliary controls and switches including interposing control, monitor relays, and interconnection coordination for monitoring of fire sprinkler system tamper, flow and air pressure switches mechanical equipment shutdown and smoke and combination fire/smoke damper controls.

C. Owner's Minimum Requirements:
   1. Provide complete smoke detection coverage in the following rooms:
      a. Booking Cells.

1.05 SEQUENCING AND SCHEDULING

A. Existing Fire Alarm Equipment: Perform functional test of existing fire alarm systems to verify the existing sequence of operations and signal transmission/interface points. Verify all existing systems that are part of the sequence of operations are in working condition. Submit documentation to show all systems, including elevator recall, elevator pressurization fans, HVAC shutdown, door release and fire smoke dampers are all functional before demolishing the existing system. If any items are not functioning the owner will review and provide direction.

B. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it “NOT IN SERVICE” until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment “NOT IN SERVICE” until removed from the building.

C. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.06 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1.07 EXTRA MATERIALS AND LABOR

A. General: Furnish and install additional devices as specified herein. For each device, include rough-in and fifty feet of raceway and wiring extended from local fire alarm circuit. Location of devices as required by authority having jurisdiction. Turn over any unused devices to the Owner and obtain signed receipt.

1. Smoke detectors: Quantity one.
2. Wall mounted horn/strobes: Quantity one.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Existing Fire Alarm and Detection System: Notifier. No substitutions.

2.02 Existing FIRE ALARM AND DETECTION SYSTEMS

A. General: Electrically operated, electrically supervised, fire alarm and detection system as described herein. Include control units, power supplies, alarm initiating and indicating devices, conduit, wire, fittings, and accessories required for a complete operating system.

B. Comply with requirements in Section 260533 for raceways, Section 260519 for conductors, Section 260534 for outlet boxes, and Section 260529 for supports. Minimum wire size No. 16 AWG for initiating circuits and No. 14 AWG for indicating circuits.

C. Enclose entire fire alarm system wiring in raceways.

D. Notification Appliance and Signaling Line Circuits: NFPA 72, Class B A.
   1. Install no more than 100 addressable devices on each signaling line circuit. Provide isolation modules on signaling line circuits: 1) on each floor where serving multiple floors, and 2) so no more than 50 addressable devices can be out of service due to a single wiring fault.

2.03 Existing SYSTEM TYPE

A. Low voltage, point identification fire management system. Fire alarm and detection system shall monitor intelligent (analog) and addressable (digital) devices, traditional initiating devices, point identify alarm location, and transmit signals to monitoring agency.

B. Fire alarm control panel shall allow for loading or editing special instructions and operating sequences. System capable of on-site programming to accommodate and facilitate expansion, building parameter changes, and changes as required by AHJs. Software operations stored in non-volatile programmable memory within fire alarm control panel. Loss of primary and secondary power shall not erase instructions stored in memory.

2.04 Existing SYSTEM OPERATION

A. Alarm displayed on an 80 character alphanumeric display and on remote printer. Top line of characters shall be point label and second line shall be device type identifier. System alarm red LED shall flash on control panel and remote annunciator shall indicate specific device in alarm. Subsequent alarm received from another zone after being acknowledged shall flash system alarm LED on control panel and remote annunciator. LCD display and printer shall show new alarm information. Alarm tone shall occur within control panel and remote annunciator until acknowledged.

B. Alarm indicating devices silenced by entering locked control cabinet and operating alarm silence switch. Subsequent alarm condition shall reactivate signals.

C. Activation of any system smoke detector shall initiate an alarm. Alarm verification operation shall be programmed into the system for future use but not active until approved by AHJ. Alarm verification function: control panel shall reset activated detector and wait for second alarm activation. If, within 1 minute after resetting, second alarm is reported from same or any other smoke detector, system shall process alarm as described previously. Time period for alarm verification reset programmable from 0 to 60 seconds. If no second alarm occurs within alarm verification time window, system shall resume normal operation. Alarm verification shall operate only on smoke detector alarms. Other activated initiating devices process immediately. Alarm verification operation selectable by device, not just by zone. Control panel with capability to display number of times zone or detector has gone into verification mode. Information displayed on control panel and transmitted to remote printer and remote annunciator.

D. Control panel shall have a dedicated supervisory trouble condition indicator and acknowledge switch.
   1. Activation of any standpipe or sprinkler valve tamper switch shall activate system supervisory service audible signal and illuminate LED at control panel and remote annunciator. Include differentiation between valve tamper activation and open circuits or ground conditions.
   2. Activating acknowledge switch shall silence audible signal while supervisory service LED.
   3. Restoring valve to normal position shall cause supervisory service LED to extinguish thus indicating restoration to normal position.

E. Alarm and trouble conditions displayed on control panel from alphanumeric display, at remote printer, and at remote annunciator. If more than one alarm or trouble is initiated, operator may scroll to display new alarms.

F. Functions of control panel field programmable.

G. Include connection from duct smoke detector relay to fan starter control circuit. Fans shut down on local detection only. Provide interposing relays as required for HVAC shutdown. Coordinate requirements with mechanical contractor and equipment vendor. Include interface relay to control system.

H. Include system output relay for alarm signaling to mechanical control system specified in Division 23.

2.05 Existing POWER REQUIREMENTS

A. Include 120 VAC power from dedicated emergency circuit for control panel.

B. Include sufficient battery capacity to operate entire system upon loss of normal 120 VAC power in normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at end of this period. System shall automatically transfer to standby batteries upon power failure. Battery charging and recharging operations shall be automatic.

C. Circuits requiring system operating power shall be 24 VDC. Include individual fuses at control panel.

2.06 Existing EQUIPMENT

A. Existing Fire Alarm Control Panel to remain.

B. Programming:
   1. Programming accomplished using a standard IBM compatible computer, either desk or laptop.
   2. Resident program stored in non-volatile EEPROM memory.
   3. System with capability to store system program on a hard disk for future changes, upgrades, and replacement.
   4. Software to allow user to reprogram system points, add system points, add or change point descriptions, and update data file. System output functions field programmable to allow custom operation.

2.07 PERIPHERAL DEVICES

A. Smoke Detectors – Vandal Resistant:
   1. General: UL 268 listed and documented compatible with control equipment to which it is connected. Photoelectric type, unless indicated otherwise, with a plug-in base and visual indication of detector actuation. Detectors intelligent, addressable and with capability of alarm verification, sensitivity adjustment by detector, and “maintenance alert” circuitry. Integral addressable module.
   2. Duct Smoke Detectors: UL 268A listed.
      a. Capable of operating in air velocity range of 300 to 2,000 feet per minute.
      b. Detectors with approved duct housing for mounting exterior to duct. Weatherproof housing for exterior locations.
      c. Perforated sampling tubes extending across width of duct and end support.
      d. Integral filter system air flow monitor to indicate presence and direction of air flow through detector.

e. Control modules and relay(s) required for equipment shutdown circuit and connection to control system. Coordinate interface with mechanical equipment and controls.

f. Where duct smoke detector is installed above a ceiling, include remote indicator lamp and magnet activated test switch mounted on ceiling below unit. Label remote lamp and test switch. Furnish test magnet to Owner.

g. Nameplate indicating corresponding mechanical equipment name and “supply air” or “return air”, as applicable.

B. Heat Detectors – Vandal Resistant: Addressable, analog thermal detectors. Rate of rise feature accomplished with electronic, dual thermistors. Include built-in test switch and LEDs to indicate alarm condition and polling. Thermal head shall plug-in to base. Heat detector rated for the environment in which it is to be installed (135° typical).

C. Heat Detectors, Weatherproof: Automatic resetting rate of rise type suitable for exterior installation. Include addressable module. Temperature rating as required by the installation, 135° F minimum. Fenwal horizontal Detect-A-Fire Series or approved equal.

D. Primary Notification Appliances: Provide flush mounted combination horn/strobe Audio/Visual signaling appliances where required. Specific audible and visual characteristics shall be as follows:

1. Visual Signals Fire Alarm: Furnish and install xenon strobes, synchronized in accordance with NFPA 72 chapter 4 and rated to UL 1971 standards. Strobes shall have a fixed candela rating, as follows: provide 15 candela in corridors and other areas up to 20’ x 20’, 75 candela in areas up to 40’ x 40’, and 110 candela in areas up to 50’ x 50’.
2. Audible Signals: Provide audible signal appliances designed to produce a minimum sound output of 85 dbA at 10’, or 15 dbA above ambient; whichever is greater.
3. Provide color matched surface mounted back boxes for surface mounted devices.

E. Multiple strobes visible in a single room coordinated to flash simultaneously.

F. Provide revisions to existing Remote Annunciators and adjacent graphic map. Working on map shall reflect information on digital readout.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.02 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.03 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.04 FIRE ALARM AND DETECTION SYSTEM INSTALLATION

A. Smoke- or Heat-Detector Spacing:
   1. Comply with NFPA 72, “Smoke-Sensing Fire Detectors” Section in the “Initiating Devices” Chapter, for smoke-detector spacing.
   2. Comply with NFPA 72, “Heat-Sensing Fire Detectors” Section in the “Initiating Devices” Chapter, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
   5. HVAC: Locate detectors not closer than 3 feet from air-supply diffusers or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

B. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

C. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

D. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

E. Mounting Heights:
   1. Manual Station: Operating handle approximately 48 inches above floor.
   2. Alarm Signal Devices: Approximately 80 inches above floor to centerline.
   3. Magnetic Door Holders: 78 inches to center line except as noted.

F. Wire:
   1. Per manufacturer’s recommendations and as per NEC. Comply with requirements in Section 260519.
   2. Where required, provide wiring in metallic conduit. Comply with requirements in Section 260533.

G. Make conduit and wiring connections to sprinkler flow switches, sprinkler valve tamper switches, and appropriate air handling equipment.

H. Label junction boxes for fire alarm with minimum 1/4 inch letters: “FIRE ALARM”.

I. Test conductors for ground conditions before making final wiring connections. Comply with requirements in Section 260526.

J. Maintain wiring color code throughout installation. Include color code identification in the Operation and Maintenance Manual.

K. Coordinate with appropriate subcontractors for installation of equipment and devices that pertain to other work in the contract.

L. Clean dirt and debris from inside and outside of the fire alarm equipment after completion of installation.

M. Coordinate installation of duct smoke detectors with Division 23 work.

N. Label all conductors in fire alarm panels, terminal blocks, and large pull boxes. Each conductor shall have a unique and specific designation.

O. All wiring shall be terminated/connected to a device, terminal block, or fire alarm panel. T-Tapping and splicing will not be permitted.

P. Wiring installed in riser conduits shall have strain relief in j-boxes so that cable and connections are maintained and not damaged.

3.05 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section “Door Hardware”. Connect hardware and devices to fire-alarm system.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated air-conditioning duct systems.
2. Alarm-initiating connection to elevator recall system and components.
3. Supervisory connections at valve supervisory switches.
4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

3.06 MANUFACTURER’S FIELD SERVICES

A. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

B. Include operations and maintenance instructions for the Owner’s representative of devices including trouble shooting procedures.

3.07 FIELD QUALITY CONTROL

A. Check out of and final connections to fire alarm control panel by factory trained technicians in employ of factory authorized franchised dealer for products installed.

B. System, upon completion of installation, checked out, final connections made, and tested to initiating and indicating devices by factory trained technicians in employ of factory franchised dealer for products installed.

C. Test completed fire alarm and detection system in accordance with NFPA 72 in presence of the Owner’s representative and the AHJ. Upon completion of successful test, certify in writing to the Owner and general contractor that system has been successfully tested and accepted by the AHJ. Include field test results in the Operation and Maintenance Manual.

3.08 RECORD DRAWINGS

A. See Section 260500 for record drawing information. Accurately identify the final location, addresses and type of each device on drawings. Divisions 26, 27, and 28 Subcontractor shall keep a set of record drawings on site during construction and programming and shall mark-up changes made on these drawings. Transfer the mark-up information to an AutoCAD 2002-2014 format CAD file at the close of the project. Provide the Owner with the mark-up drawings, a CAD plot and CAD file on disk.

B. Provide a complete printout hard copy of the system program and an electronic backup copy or the site specific software for all future programming needs by authorized manufacturer/distributor per NFPA 72 4,5,2,3.(3).

END OF SECTION