

## SECTION 019100 – GENERALCOMMISSIONING REQUIREMENTS

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Description

1. Commissioning is the systematic process of verifying and documenting that all building systems perform according to the design intent, the Owner's operational needs, to maximize efficiency/stability, and to ensure that the Owner is provided with useful and clear training and documentation necessary to operate and maintain the building systems.
2. Commissioning is the Quality Assurance (QA) portion of a QA/QC (Quality Assurance/Quality Control) program as it is applied to the construction process. The Contractor shall be responsible for providing Quality Control by verifying that the systems are installed per the contract documents/code requirements and by verifying the basic integrity and operation of the installed equipment/systems by performing the testing and startup requirements found within the project specifications (i.e. – duct leakage testing, manufacturer's startup requirements, DDC point to point testing, electrical 3<sup>rd</sup>-party testing, etc.). The Contractor shall also be responsible for providing Quality Assurance in the form of the Commissioning process for the project, as led by the Contractor's Test Engineer. The Owner's Commissioning Authority shall be responsible for ensuring that the Commissioning requirements are met for the project.
3. No actions by the Commissioning Authority shall diminish the Contractor's responsibility from complying with the plans and specifications.

#### 1.02 RELATED REQUIREMENTS

- A. Section 01 75 00 – Test Engineer Services
- B. Section 22 08 00 – Commissioning of Plumbing
- C. Section 23 08 00 – Commissioning of HVAC
- D. Section 26 08 00 – Commissioning of Electrical
- E. Section 28 08 00 – Commissioning of Electronic Safety and Security

#### 1.03 LEED REQUIREMENTS

- A. The owner has established that the project will achieve LEED Certification.
  1. The requirements of the following LEED credits are mandatory for the work included in this section in order to achieve LEED certification.
    - a. Energy and Atmosphere: Prerequisite 1 – Fundamental Building Commissioning,
    - b. Energy and Atmosphere: Credit 3 – Enhanced Commissioning.

#### 1.04 COMMISSIONING GOALS

- A. The commissioning process will be executed to meet the following goals:
  1. Clarify the operational design intent where there are different interpretations between the Commissioning Team members.

2. Integrate commissioning activities into the general construction schedule (project master schedule) such that commissioning is complete, except as noted elsewhere in this section, at the time of Substantial Completion for the project. The Commissioning Authority and Contractor shall maximize the ability and opportunity to allow early system testing.
3. Ensure that equipment is installed correctly per the contract documents and code requirements and in a manner that maximizes efficiency/performance and provides sufficient access for maintenance/operation utilizing manufacturer's guidelines as minimum criteria.
4. Provide oversight of the Contractor's equipment/system startup and testing requirements as defined in the contract documents.
5. Provide and execute a set of repeatable, step-by-step set of testing procedures (Functional Performance Tests, also referred to as FPT's) in order to demonstrate system compliance with the design intent and are optimized to operate with minimal energy usage,
6. Identify system installation and operational deficiencies and ensure that resolution to those deficiencies occur in a timely manner.
7. Ensure that the O&M documentation submitted to the Owner is complete, clearly organized, and useful.
8. Ensure that the As-Built information has been completed and submitted to the Owner.
9. Ensure that Owner's operating personnel are sufficiently trained in order to achieve necessary technical, safety, operational, and maintenance knowledge before the time of building systems turnover to the Owner.

#### 1.05 COMMISSIONED SYSTEMS SCOPE

- A. The following equipment/systems shall be commissioned. Refer to related specification sections for further details. The five columns at the right side of the matrix below represent the five major commissioning activities and how they apply to each of the commissioned equipment/systems. Refer to Part 3, "Commissioning Process", of this specification section for further description of each of the five major commissioning activities.

Equipment and Systems to be Commissioned:	Installation Audit	Startup Oversight	Functional Performance Test	O&M/As-Built Oversight	Owner Training Oversight
<b>Section 21 08 00: Plumbing Systems to be Commissioned:</b>					
Piping Distribution System – Domestic Hot, Cold, and Recirculation	√	√		√	√
Piping Distribution System – Sanitary Waste and Vent	√	√		√	√
Piping Distribution System – Lab Hot, Cold, and Recirculation	√	√		√	√
Piping Distribution System – Lab Waste and Vent	√	√		√	√
Piping Distribution System – Lab High Purity Water	√	√		√	√
Piping Distribution System – Lab Gasses	√	√	√	√	√

Equipment and Systems to be Commissioned:	Installation Audit	Startup Oversight	Functional Performance Test	O&M/As-Built Oversight	Owner Training Oversight
Water Service Cross Connection (RPBP's)	√	√		√	√
Emergency Eyewash and Shower Equipment and Systems	√	√		√	√
Water Service Pressure Regulation (Pressure Reducing Valves)	√	√	√	√	√
Trap Primers Equipment and Systems	√	√	√	√	√
High Purity Pumps	√	√	√	√	√
Lab Circulation Pump	√	√	√	√	√
Domestic/Lab Water Booster Pumps	√	√	√	√	√
Steam Water Heaters	√	√	√	√	√
Compressed Air Refrigerated Air Dryers	√	√	√	√	√
Vacuum Pumps	√	√	√	√	√
Testing, Adjusting and Balancing		√	√	√	√
Direct Digital Controls System	√	√	√	√	√
Interfaces to Emergency Power Systems			√		
<b>Section 23 08 00: HVAC Systems to be Commissioned:</b>					
Piping Distribution System – Heating Hot Water	√	√		√	√
Piping Distribution System – Process Hot Water	√	√		√	√
Piping Distribution System – Heat Recovery Water	√	√		√	√
Piping Distribution System – Heated Glycol Water	√	√		√	√
Piping Distribution System – Chilled Water	√	√		√	√
Piping Distribution System – Process Chilled Water	√	√		√	√
Ductwork Distribution Systems	√	√		√	√
Air Cooled Chiller and Pumping Systems	√	√	√	√	√
Water Cooled Chiller and Pumping Systems	√	√	√	√	√
Chilled Beams	√	√	√	√	√
Heat Recovery Loop and Pumping Systems	√	√	√	√	√
Radiant Floor Loop and Pumping Systems	√	√	√	√	√
Steam Loop	√	√	√	√	√
Steam Generators/Humidifiers	√	√	√	√	√
Steam Pressure Reducing Valves	√	√		√	√
Condensate Pump/Receiver Units	√	√	√	√	√
Air Handling Unit Systems and Pumps	√	√	√	√	√
Miscellaneous Supply and Exhaust Fan Systems	√	√	√	√	√
Powered Wind Turbine Ventilators	√	√	√	√	√
Room Level HVAC – Air Terminal Units	√	√	√	√	√

Equipment and Systems to be Commissioned:	Installation Audit	Startup Oversight	Functional Performance Test	O&M/As-Built Oversight	Owner Training Oversight
Room Level HVAC – Reheat Coils	√	√	√	√	√
Room Level HVAC – Electric Heaters (Baseboard, Wall, Ceiling)	√	√	√	√	√
Fume Hood Equipment and Systems	√	√	√	√	√
Ceiling Fan	√	√	√	√	√
Fin Tube Radiators (FTR)	√	√	√	√	√
Unit Heaters (Hydronic)	√	√	√	√	√
HVAC Water Treatment Systems	√	√	√	√	√
Testing, Adjusting, and Balancing		√	√	√	√
Direct Digital Controls Systems	√	√	√	√	√
Interfaces to Fire Alarm Systems			√		
Interfaces to Emergency Power Systems			√		
<b>Section 26 08 00: Electrical Power Systems to be Commissioned:</b>					
Lighting Control Systems	√	√	√	√	√
EC (Electrical Subcontractor) – Electrical Control Devices		√		√	√
EC – Receptacles		√		√	√
EC – < 600V Wiring		√		√	√
EC – Dimmable Fluorescent Lamp Burn-In		√		√	√
EC – Power Systems Tests (Post Occupancy Testing)		√	√	√	√
EC – Blackout, Emergency Power, and Normal Power Restoration			√		
3 <sup>rd</sup> Party ETC (Electrical Testing Subcontractor) – Service Grounding		√	√	√	√
3 <sup>rd</sup> Party ETC – Ground Fault Protection System		√	√	√	√
3 <sup>rd</sup> Party ETC – Dry Type Transformers		√	√	√	√
3 <sup>rd</sup> Party ETC – Motor Control Centers		√	√	√	√
3 <sup>rd</sup> Party ETC – Automatic Transfer Switches		√	√	√	√
3 <sup>rd</sup> Party ETC – Substations and Switchboards		√	√	√	√
3 <sup>rd</sup> Party ETC – Molded Case Circuit Breakers		√	√	√	√
3 <sup>rd</sup> Party ETC – Metering		√	√	√	√
3 <sup>rd</sup> Party ETC – Primary Voltage Cables		√	√	√	√
3 <sup>rd</sup> Party ETC – Primary Switchgear		√	√	√	√
3 <sup>rd</sup> Party ETC – Coordination Study Settings		√	√	√	√
<b>Section 28 08 00: Electronic Safety and Security Systems to be Commissioned:</b>					
Security Card Access Control System	√	√	√	√	√
Fire Alarm System (UW Demonstration and SFD Confidence Testing)		√			√
Fire Alarm Interfaces – Emergency Power Operation			√		

## PART I GENERAL

### 1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Shaft wall system.
- C. Gypsum sheathing.
- D. Perforated gypsum board.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Glass mat faced gypsum board.
- H. Joint treatment and accessories.

### 1.2 RELATED REQUIREMENTS

- A. Section 014600 - Seismic Design Requirements For Nonstructural Systems.
- B. Section 054000 - Cold Formed Metal Framing: Exterior and interior load-bearing metal stud framing.
- C. Section 06 10 00 - Rough Carpentry: backing behind plastic laminate used on walls and at head walls.
- D. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- E. Section 078410 - Partition-Head Firestopping: Top-of-wall assemblies at fire rated walls.
- F. Section 079200 - Joint Sealers: Acoustic sealant.
- G. Section 09 22 16 - Non-Structural Metal Framing.
- H. Section 09 30 00 - Tiling: Tile backing board.
- I. Division 9 sections for various wall coverings
- J. Division 10 sections for various wall protection products

### 1.3 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 1999 (R2005).
- C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (R2005).
- D. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.
- E. ASTM C423-99a Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

- F. ASTM C 475/C 475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002 (Reapproved 2007).
  - G. ASTM C 645 - Standard Specification for Nonstructural Steel Framing Members; 2007.
  - H. ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2007.
  - I. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board; 2007.
  - J. ASTM C 954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2007.
  - K. ASTM C 1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.
  - L. ASTM C 1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2005.
  - M. ASTM C 1177/C 1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2006.
  - N. ASTM C 1178/C 1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2006.
  - O. ASTM C 1278/C 1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2007a.
  - P. ASTM C 1280 - Standard Specification for Application of Gypsum Sheathing; 2007.
  - Q. ASTM C 1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets; 2004.
  - R. ASTM C 1278/C1278M Standard Specification for Fiber-Reinforced Gypsum Panel
  - S. ASTM C 1396/C 1396M - Standard Specification for Gypsum Board; 2006a.
  - T. ASTM C 1658/C 1658M - Standard Specification for Glass Mat Gypsum Panels; 2006.
  - U. ASTM D 3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2000 (Reapproved 2005).
  - V. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2004.
  - W. ASTM E 413 - Classification for Rating Sound Insulation; 2004.
  - X. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2007.
  - Y. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 1996.
  - Z. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2006.
  - AA. ICC (IBC) - International Building Code; 2006.
  - AB. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.
- 1.4 SUBMITTALS
- A. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
  - B. Product Data: Provide data on metal framing, gypsum board, accessories, joint finishing system,

and fasteners.

- C. **Product Data:** Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. **Test Reports:** For all stud framing products that do not comply with ASTM C 645 or C 754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

#### 1.5 QUALITY ASSURANCE

- A. Maintain one copy of all installation standards at project site.
- B. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.
  - 1. Maintain one copy of standards at project site.
- C. **Installer Qualifications:** Company specializing in performing gypsum board application and finishing, with minimum 3 years of documented experience.
- D. **Designer Qualifications:** Design framing system for perforated gypsum assembly under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the state in which the project is located.

#### 1.6 MOCK-UP

- A. Construct mock-up for perforated gypsum ceiling, incorporating all components specified for the location. Include joint between ceiling sections.
- B. Refer to drawings for extents.
- C. Illustrate use of all accessory units and termination types (corners, bullnose, tile to concrete edge strip, etc.)
- D. Approved mock-up may remain as part of the Work.

#### 1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire rated assemblies as indicated on drawings.

### PART 2 PRODUCTS

#### 2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C 840 and GA-216.
  - 1. See PART 3 for finishing requirements.
- B. **Interior Partitions Indicated as Acoustic:** Provide completed assemblies with the following characteristics:
  - 1. **Acoustic Attenuation:** STC of 50-54 calculated in accordance with ASTM E 413, based on tests conducted in accordance with ASTM E 90.
- C. **Shaft Walls at HVAC Shafts:** Provide completed assemblies with the following characteristics:
  - 1. **Air Pressure Within Shaft:** Sustained loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240.
  - 2. **Acoustic Attenuation:** STC of 40-44 calculated in accordance with ASTM E 413, based on tests conducted in accordance with ASTM E 90.
- D. **Shaft Walls at Elevator Shafts:** Provide completed assemblies with the following characteristics:

1. Air Pressure Within Shaft: Intermittent loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240.
2. Acoustic Attenuation: STC of 50-54 calculated in accordance with ASTM E 413, based on tests conducted in accordance with ASTM E 90.
- E. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
  1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
  2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
  3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL Fire Resistance Directory.

## 2.2 FRAMING MATERIALS

- A. Interior and exterior Non-Loadbearing Studs, Shaft wall and Furring for Application of Gypsum Board: As specified in Section 09 22 16.
- B. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 40 00.
- C. Shaft Wall Studs and Accessories: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 and specified performance requirements.
- D. Ceiling Hangers: Type and size as specified in ASTM C 754 for spacing required.
- E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
  1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
  2. Material: ASTM A 653/A 653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
  3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems specified in Section 078410.
  4. Deflection and Firestop Track:
    - a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.

## 2.3 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board: Products listed are as "basis of design" only and are not intended to be the only possible products.
  1. Georgia-Pacific Gypsum LLC: [www.gp.com/gypsum](http://www.gp.com/gypsum).
  2. USG Corporation: [www.usg.com](http://www.usg.com).
  3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Wallboard:
  1. Application: Use for vertical surfaces, unless otherwise indicated.
  2. Paper faced gypsum wallboard as defined in ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
  3. Glass-mat-faced gypsum panels as defined in ASTM C 1658/C 1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
  4. Unfaced fiber-reinforced gypsum panels as defined in ASTM C 1278/C 1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
  5. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly;

- if no tested assembly is indicated, use Type X board, UL or WH listed.
6. Thickness:
    - a. Vertical Surfaces: 5/8 inch. 1/2 inch where noted.
    - b. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
  7. Edges: Tapered
  8. Paper-Faced Products:
    - a. Georgia-Pacific Gypsum LLC; ToughRock Gypsum Wallboard.
    - b. USG Corporation; Sheetrock Brand Gypsum Panels.
  9. Glass-Mat-Faced Products:
    - a. Georgia-Pacific Gypsum LLC; DensArmor Plus.
  10. Unfaced Products:
    - a. USG Corporation; Fiberock Aqua-Tough Interior Panels.
- C. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet or highly humid areas including tub and shower surrounds and shower ceilings, all areas behind FRP, at tiled areas unless noted below, kitchens or other areas subjected to regular wetting.
    - a. Tiled areas NOT requiring backing board:
      - 1) none listed at this time
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D 3273.
  3. ANSI Cement-Based Board: Non-gypsum-based; aggregated portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C 1325.
    - a. Thickness: 1/2 inch.
    - b. Products:
      - 1) USG Corporation; Durock Brand Cement Board.
  4. Glass-Mat-Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C 1178.
    - a. Standard Type: Thickness 1/2 inch.
    - b. Fire-Resistant Type: Type X core, thickness 5/8 inch.
    - c. Products:
      - 1) Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
- D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C 1396/C 1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas and at emergency shower and floor sink locations.
  2. Type: Regular and Type X, in locations indicated.
  3. Type X Thickness: 5/8 inch.
  4. Regular Board Thickness: 1/2 inch.
  5. Edges: Tapered.
  6. Products:
    - a. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
    - b. USG Aqua-Tough
    - c. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
- E. Ceiling Board: Special sag-resistant gypsum ceiling board as defined in ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
  2. Thickness: 1/2 inch.
  3. Edges: Tapered.
  4. Products:
    - a. Georgia-Pacific Gypsum LLC; ToughRock CD Ceiling Board.
    - b. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.

- F. Fire Resistant Type: Complying with Type X requirements; UL or WH rated.
  - 1. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
    - a. Other Applications: Use at all vertical surfaces, unless otherwise indicated.
    - b. Thickness: 5/8, 3/4 and 1 inch.
  - 2. Edges: Tapered.
  - 3. Special Fire Resistant Type: "Type C"; meeting and exceeding requirements of Type X; UL or WH rated.
    - a. Application: Where required for fire-rated assemblies, unless otherwise indicated.
    - b. Thickness: 5/8 inch.
    - c. Edges: Tapered.
  - 4. Ceiling Board: Special sag-resistant type.
    - a. Application: Ceilings, unless otherwise indicated.
    - b. Thickness: 1/2 inch.
    - c. Edges: Tapered.
- G. Gypsum Sheathing Board: ASTM C 1369/C 1369M, moisture resistant type; sizes to minimize joints in place; water repellent faces; ends square cut.
  - 1. Application: Exterior sheathing, unless otherwise indicated.
  - 2. Glass-Mat-Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C 1177/C 1177M.
  - 3. Unfaced Sheathing: Water-resistant exterior fiber-reinforced gypsum sheathing panels as defined in ASTM C 1278/C 1278M, and exceeding the relevant requirements of ASTM C 1177/C 1177M.
  - 4. Thickness: 5/8 inch. or as indicated
  - 5. Edges: Square, for vertical application.
  - 6. Glass-Mat-Faced Products:
    - a. Georgia-Pacific Gypsum LLC; DensGlass Gold Sheathing.
  - 7. Unfaced Products:
    - a. USG Fiberoak Brand Aqua-Tough Sheathing Panels.
- H. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
  - 2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
  - 3. Types: Regular and Type X, in locations indicated.
  - 4. Type X Thickness: 5/8 inch.
  - 5. Regular Type Thickness: 5/8 inch.
  - 6. Edges: Tapered.
  - 7. Products:
    - a. Georgia-Pacific Gypsum LLC; ToughRock Soffit Board.
    - b. USG Corporation; Sheetrock Exterior Gypsum Ceiling Board.
- I. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
  - 1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C 1658/C 1658M.
  - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D 3273.
    - a. Use mold resistant products when liner is within 1 story of an elevator pit, is within 2 stories of top of the shaft with an open roof, near any standing water or other constantly wet area.
  - 3. Products:
    - a. Georgia-Pacific Gypsum LLC; DensGlass Ultra Shaftliner (mold-resistant).

- b. USG Corporation; Sheetrock Gypsum Liner Panels--Enhanced (mold-resistant).
- J. Perforated Gypsum Board: Gypsum panel with acoustic perforation and black acoustic backing.
  - 1. Basis of Design: Subject to compliance with requirements, provide Vogl Pyrok or equivalent.
  - 2. Surface Burning Characteristics: Per ASTM E 84:
    - a. Flame Spread: 20 or less
    - b. Smoke Developed Index: 20 or less
  - 3. Sound Absorption: NRC 0.65 per ASTM C423.
  - 4. Perforations:
    - a. Pattern: 8/18 Square.
    - b. Open Area: 19-20 percent.

#### 2.4 ACCESSORIES

- A. Acoustic Insulation: As specified in Section 07 21 00.
- B. Acoustic Sealant: As specified in Section 079200.
- C. Finishing Accessories: ASTM C 1047, galvanized steel or rolled zinc, unless otherwise indicated.
  - 1. Types: As detailed or required for finished appearance.
  - 2. Special Shapes: In addition to conventional cornerbead and control joints, provide U-bead at exposed panel edges and as detailed
- D. Reveals and other specialty trim as detailed including but not limited to the following:
  - 1. Reveal Molding; depth of gypsum board x 1/4 inch wide.
  - 2. "J" Molding:
- E. Butt Stripping: Hardened cardboard furring strips: 1-1/2 inches wide by 1/4 inch thick
  - 1. at Wall and Ceiling Supply Company Seattle 206-723-7403
- F. Joint Materials: ASTM C 475 and as recommended by gypsum board manufacturer for project conditions.
  - 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
  - 2. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
  - 3. Ready-mixed vinyl-based joint compound.
  - 4. Powder-type vinyl-based joint compound.
  - 5. Chemical hardening type compound also called "Setting type" compounds.
- G. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
  - 1. Product: TUFF-HIDE Primer-Surface manufactured by USG. Use at any gypsum or cement board wall scheduled for level 5 finish. (excluding tiled or wet areas)
  - 2. Product: Cover Coat manufactured by USG. Use at concrete ceilings and walls if scheduled for level 4 or 5 finish.
- H. Acrylic Finish for Exterior Soffit Board:
- I. Screws for Attachment to Steel Members Less Than 0.03 inch In Thickness, to Wood Members, and to Gypsum Board: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.
- J. Screws for Attachment to Steel Members From 0.033 to 0.112 Inch in Thickness: ASTM C 954; steel drill screws for application of gypsum board to loadbearing steel studs.
- K. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations. As

recommended by manufacturer for application and substrate.

- L. Screws: ASTM C 954; steel drill screws for application of gypsum board to loadbearing steel studs.
- M. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

#### 3.2 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
  - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
  - 2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
  - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
  - 2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

#### 3.3 FRAMING INSTALLATION

- A. Comply with Sections 054000 or 092216.
- B. Metal Framing: Install in accordance with ASTM C 754 and manufacturer's instructions.
- C. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
  - 1. Level ceiling system to a tolerance of 1/1200.
  - 2. Laterally brace entire suspension system.
- D. Studs: Space studs as scheduled.
  - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
  - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to structural framing in accordance with details.
  - 3. 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. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- F. Blocking: Install mechanically fastened steel sheet or channel blocking for support of:
  - 1. Framed openings.
  - 2. Wall mounted cabinets.
  - 3. Plumbing fixtures.
  - 4. Toilet partitions.
  - 5. Toilet accessories.
  - 6. Wall mounted door hardware.
- G. Use Butt Stripping for use at areas of framing that are not flat, at areas where Metal Strap Backing is used as the metal strips will cause a "bump" in the finished wall.

### 3.4 ACOUSTIC AND AIR SEAL ACCESSORIES INSTALLATION

- A. Install to meet sound requirements in acoustical report.
- B. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- C. Maintain a 1/4 inch Gap at the head and foot of each layer of gypsum board on the wall to receive sealant.
- D. Acoustic Sealant: Install per details and as follows:
  - 1. Place one bead continuously on substrate before installation of perimeter framing members.
  - 2. Place continuous bead at perimeter of each layer of gypsum board.
  - 3. In both rated and non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.
    - a. At boxes use Hilti Putty pad or approved. Seal tightly to box and adjoining gypsum board.
    - b. At penetrations install detailed sleeve and fill space between penetrating item and sleeve with mineral fiber insulation. Seal both ends with rated or non rated sealant depending upon wall rating.

### 3.5 BOARD INSTALLATION

- A. Comply with ASTM C 840. Install to minimize butt end joints, especially in highly visible locations.
- B. Install all Gypsum glass mat faced board and cement board products in strict accordance with the manufacturer's instructions and guidelines
- C. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- D. Double-Layer Non-Rated: Use gypsum board for first layer, placed perpendicular to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- E. High Impact Board:
  - 1. Use at all rigid wall coverings except plastic laminate.
  - 2. At finishes backed with very high impact board stop the board just inside the edge of the finish, allowing a smooth looking transition to regular strength wall board.
- F. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- G. Exterior Sheathing: Comply with ASTM C 1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
  - 1. Immediately after installation, protect from weather by application of air barrier (07270) or other temporary weather resistive barrier.
  - 2. At Soffits: Install perpendicular to framing, with staggered end joints over framing members or other solid backing.
- H. Cementitious Backing Board: Install over studs where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- I. Glass Mat Faced Gypsum Board: Use fiberglass tape, do not use an additional vapor retarder behind the units See manufacturer's instructions.
- J. Installation on Metal Framing: Use screws for attachment of all gypsum board except face

layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

- K. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.
- L. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board with sealant.

### 3.6 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
  - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths, square profile unless otherwise noted.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

### 3.7 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C 840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Cementitious Backing Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- E. Finish gypsum board in scheduled areas in accordance with levels defined in ASTM C 840 and as scheduled below.
- F. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
  - 2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
  - 3. Taping, filling and sanding is not required at base layer of double layer applications.
- G. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- H. Spray apply high build drywall surfacer over entire surface after joints have been properly treated to achieve Level 5 finish in areas indicated.
- I. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

### 3.8 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

### 3.9 FINISH LEVEL SCHEDULE

- A. Level 1: Above finished ceilings concealed from view.

- B. Level 2: Utility areas and areas behind cabinetry.
- C. Level 3: NOT USED Walls and columns scheduled to receive textured wall finish.
- D. Level 4: Walls, columns and ceilings scheduled to receive flat or eggshell paint finish.
- E. Level 5: Walls, columns and ceilings scheduled to receive semi-gloss or gloss paint finish.
- F. Level 5: at all use of Impact resistant gypsum board.
- G. Level 5: at all corridors, elevator lobbies, exposed interior concrete ceiling.

END OF SECTION

## **PART 1 GENERAL**

### **1.1 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Ceramic accessories.
- D. Ceramic trim.
- E. Non-ceramic trim.
- F. Anti-fracture membrane

### **1.2 RELATED REQUIREMENTS**

- A. Section 07 14 10: Fluid-Applied Interior Waterproofing: for interior waterproofing membrane.
- B. Section 07 92 00 - Joint Sealers.
- C. Section 09 21 16 - Gypsum Board Assemblies: Installation of tile backer board.
- D. Division 22 - Plumbing: Toilet room fixtures.

### **1.3 REFERENCE STANDARDS**

- A. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2005.
  - 1. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2005.
  - 2. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar; 1999 (R2005).
  - 3. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex Portland Cement Mortar; 1999 (R2005).
  - 4. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 1999 (R2005).
  - 5. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (R2005).
  - 6. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (R2005).
  - 7. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (R2005).
  - 8. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (R2005).
  - 9. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (R2005).
  - 10. ANSI A118.1 - American National Standard Specifications for Dry-Set Portland Cement Mortar; 1999 (R2005).
  - 11. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 1999 (R2005).
  - 12. ANSI A118.4 - American National Standard Specifications for Latex-Portland Cement

- Mortar; 1999 (R2005).
- 13. ANSI A118.7 - American National Standard Specifications for Polymer Modified Cement Grouts for Tile Installation; 1999 (R2005).
- 14. ANSI A118.8 - American National Standard Specifications for Modified Epoxy Emulsion Mortar/Grout; 1999 (R2005).

- B. TCA (HB) - Handbook for Ceramic Tile Installation; Tile Council of North America, Inc.; 2007/2008.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

#### 1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's data sheets on membranes, tile, mortar, grout, and accessories. Include instructions for using membranes, grouts and adhesives.
- B. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.
- C. Shop Drawings: Indicate membrane and tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details and related dimensioning as well as plumbing (drains) mechanical and electrical fixtures and lines installed.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 x 18 inches in size (minimum) illustrating pattern, color variations, and grout joint size variations.
  - 1. Include cut and ground thru-body unglazed tile with edge exposed and edge set in grout for approval of grinding.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

#### 1.6 QUALITY ASSURANCE

- A. Maintain one copy of TCA Handbook and ANSI A108 Series/A118 Series on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

#### 1.7 MOCK-UP

- A. Construct tile mock-up where indicated on the drawings, incorporating all components specified for the location.
- B. Minimum size of mock-up is 2 x 2 x 2 feet minimum and/or indicated on the drawings.
- C. Illustrate use of all accessory units and termination types (corners, bullnose, tile to concrete edge strip, etc.)
- D. Approved mock-up may remain as part of the Work.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.
- B. Store membranes off of ground. Store rolled goods vertically

#### 1.9 FIELD CONDITIONS

- A. Do not install adhesives in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

#### 1.10 EXTRA MATERIALS

- A. Provide 2-1/2 percent of each size, color, and surface finish of tile specified, but not less than 10 sf of each type.

### PART 2 PRODUCTS

#### 2.1 TILE PRODUCTS

- A. Provide floor and wall tile products listed in Section 09 05 02 Finish Materials.

#### 2.2 TILE

##### A. General

- 1. Blending: For tiles with color variations, factory blend and package tile so each package has the same range of colors and quantities of each variation. If factory blending is not available, field blend prior to beginning installation.
- 2. Coefficient of Friction (COF)
  - a. General: There is no national standard for slip resistance. Use the following as guides for providing tile for this work.
    - 1) For any tile provide data that states the type of test apparatus, method of test and result. As machines and test methods vary so will results. the numbers listed below are to be used as a guide.
  - b. Provide tile test data:
    - 1) For ADA accessible areas: ADAAG recommends a COF of 0.06 flat and 0.08 for ramps when measured with a NBS-Brungraber machine using a silastic sensor shoe on dry surfaces.
    - 2) For dry flat surfaces for other than ADA accessibility a COF of 0.05 is referenced in the literature.

#### 2.3 TRIM AND ACCESSORIES

- A. Ceramic Accessories: Unless noted otherwise, accessories for glazed, unglazed finish, same color and finish as adjacent field tile; same manufacturer as tile. Use only as detailed.
  - 1. Use ceramic trim if it is available for tile selected. If not use non-ceramic trim below.
- B. Ceramic Trim: Matching cove base and cove ceramic shapes in sizes coordinated with field tile.
  - 1. Applications: Use in the following locations:
    - a. Open Edges: Bullnose.
    - b. Inside Corners: Cove.
    - c. Floor to Wall Joints: Cove base.
  - 2. Manufacturer: Same as for tile.
- C. Non-Ceramic Trim: style and dimensions to suit application, for setting using tile mortar or adhesive.
  - 1. Applications: Use in the following locations:
    - a. Open edges of wall tile: Schluter Jolly color SP.
    - b. Open edges of floor tile adjoining other floor finishes of different depths: Schluter Schiene Color AE.
    - c. Borders and other trim as indicated on drawings.
    - d. Outside corners: Schluter Quadec: brushed Stainless Steel U.N.O.
  - 2. Finish: Brushed stainless steel unless noted otherwise.
  - 3. Manufacturer:

- a. Schluter-Systems: [www.schluter.com](http://www.schluter.com).
- b. Genesis APS International: [www.genesis-aps.com](http://www.genesis-aps.com).
- c. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.4 ADHESIVE MATERIALS

- A. Manufacturers:
  1. Bonsal American, Inc: [www.sakrete.com](http://www.sakrete.com)
  2. Custom Building Products.
  3. Laticrete International.
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Epoxy Adhesive: ANSI A118.3, thinset bond type.
  1. Use at floors requiring chemical resistance, with stone tile, with stone or other tile mounted with resin to mesh backing, and where scheduled.

## 2.5 MORTAR MATERIALS

- A. Manufacturers:
  1. Bonsal American, Inc; Product \_\_\_\_: [www.sakrete.com](http://www.sakrete.com)
  2. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
  3. Laticrete International.
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Mortar Bed Materials: Portland cement, sand, latex additive and water.
  1. Dry premixed mortars are encouraged
- C. Mortar Bond Coat Materials:
  1. Dry-Set Portland Cement type: ANSI A118.1.
  2. Latex-Portland Cement type: ANSI A118.4.
  3. Epoxy: ANSI A118.3.

## 2.6 GROUT MATERIALS

- A. Manufacturers:
  1. Bonsal American, Inc.; Product \_\_\_\_: [www.sakrete.com](http://www.sakrete.com)
  2. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
  3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Grout: Polymer modified cement grout, sanded or unsanded, as specified in ANSI A118.7.
  1. Color: As selected.
- C. Epoxy Grout: ANSI A118.8, modified epoxy emulsion grout, color as selected.

## 2.7 ACCESSORY MATERIALS

- A. Antifracture Membrane
  1. Laticrete Blue 92
  2. Others as approved.
- B. Waterproofing Membrane at Floors: As specified in Section 07 14 10.
- C. Sealant: per Section 07 92 00

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify Deflection of floor using note "Maximum Allowable Deflection..." under the headline Notes / Definitions in the TCA manual. This limit 1/360 with a 300 lb concentrated load shall be doubled to 1/720 for stone tiles.

- B. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- C. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- D. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- E. Verify that concrete surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
  - 1. Moisture emission rate: Not greater than 3 to 5 lb per 1000 sq ft per 24 hours when tested using calcium chloride moisture test kit for 72 hours.
  - 2. Alkalinity: pH range of 5-9.
- F. Verify that required wall-mounted and floor-mounted utilities are in correct location.

### 3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Strip, abrade or otherwise remove existing material from existing sub-floor surfaces that will impair bond to new flooring installation.
- C. Vacuum clean surfaces and damp clean.
- D. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.
- F. Prepare surfaces to receive glass tiles: substrate must be clear of all writing or company logos as these will show thru any gaps in the thinset. Apply thinset evenly to achieve a consistent surface below the glass tile as any gaps in the thinset will expose the substrate beneath.
- G. Install anti-fracture membrane following manufacturer's recommendations.
  - 1. Honor expansion joints. If not detailed submit RFI.
  - 2. Treat control joints per manufacturers instructions

### 3.3 INSTALLATION - GENERAL

- A. Dry set large format floor tiles and receive Architect's approval prior to wet setting the floor.
- B. Install tile and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and TCNA Handbook recommendations.
- C. Extend tilework into recesses and under or behind fixtures and cabinets to form a complete covering without interruptions. Terminate work neatly at obstructions, edges, and corners.
- D. Under all tile not scheduled for waterproofing provide anti-fracture membrane.
- E. Large format tile : Large tiles (8 inches or larger in any dimension) must be installed per the note on bonding large-format tile in the TCNA manual under the heading of Notes/Definitions.
  - 1. leave a 1/4 inch joint at all walls. fill this joint with 100% silicone sealant to allow for movement.
- F. Ground Tile: When partial tiles must be used on exposed edges:
  - 1. Grind the edges of cut unglazed thru-body tile to mimic the factory edge and place the cut edge in.
  - 2. If a cut edge must face out. grind with fine enough grit to match the finish texture of the tile as close as possible.
  - 3. Submit samples for approval prior to commencing work.

- G. Lay tile to pattern indicated.
  - 1. Do not interrupt tile pattern through openings.
  - 2. Align floor, base, wall, and trim joints where sizes permit.
  - 3. Lay out tilework and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting.
- H. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align base and wall joints.
- I. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
  - 1. Ceramic Mosaic Floor Tile: 1/16 inch.
  - 2. Paver Tile: 1/4 inch.
  - 3. Glazed Wall Tile: 1/16 inch.
- J. Form internal angles square and external angles bullnosed.
- K. Install ceramic accessories rigidly in prepared openings.
- L. Install non-ceramic trim in accordance with manufacturer's instructions.
- M. Sound tile after setting. Replace hollow sounding units.
- N. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- O. Allow tile to set for a minimum of 48 hours prior to grouting.
- P. Grout tile joints.
- Q. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

#### 3.4 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCA Handbook Method F122-05, with standard grout.
  - 1. Where waterproofing membrane is indicated, install in accordance with TCA Handbook Method F122.
  - 2. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F131.

#### 3.5 INSTALLATION - SHOWERS AND BATHTUB WALLS (or other WET WALLS)

- A. At tiled shower receptors install in accordance with TCA Handbook Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
- B. At bathtub and shower walls install in accordance with TCA Handbook Method B412, over cementitious backer units with waterproofing membrane and B420 for showers
- C. Grout with epoxy grout.
- D. Seal joints between tile work and other work with sealant Typespecified in Section 07 92 00.

#### 3.6 INSTALLATION - WALL TILE

- A. Over cementitious backer units on studs, install in accordance with TCA Handbook Method W244Apply waterproofing membrane as scheduled.
  - 1. The system is altered in one way. the waterproofing lays on top of the cement backer board and not behind it as shown in the TCA assembly.
- B. Over coated glass mat backer board on studs, install in accordance with TCA Handbook Method W245.
- C. Over gypsum wallboard on wood or metal studs install in accordance with TCA Handbook Method W243, thin-set with dry-set or latex-portland cement bond coat, unless otherwise

indicated.

1. Where waterproofing membrane is indicated other than at showers and bathtub walls, install in accordance with TCA Handbook Method W222, one coat method.

- D. Over interior concrete and masonry install in accordance with TCA Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.

- E. Slope tile floors to drain. warp tiles (especially large ones) at all costs prior to cutting.

### 3.7 ERECTION TOLERANCES

- A. Lippage: Per ANSI 108.

<u>Material</u>	<u>Size</u>	<u>Joint width</u>	<u>Allowable Lippage</u>
Glazed Wall/Mosaics	1" x1" to 6" x 6"	1/8" or less	1/32"
Quarry	6" x 6" and larger	1/4" or greater	1/16"
Paver	All	1/8" to 1/4"	1/32"
Paver	All	1/4" or greater	1/16"

1. The ANSI A137.1 standard defined allowed warpage according to the type of tile.
2. 5.3.1.2.6 Warpage. For example paver tiles, when measured as described in ASTM C 485, the warpage of each tile in the sample shall not exceed 1.0 percent along any edge nor 0.75 percent on either diagonal. From this formula the allowable warpage can be determined.
3. The amount of allowable tile warpage is not used in the calculation of allowable lippage. Rather, allowable lippage is the total of the inherent (i.e. actual) tile warpage and the allowable lippage from the table above. Of course, the actual warpage should not exceed the allowable warpage as calculated above.

### 3.8 CLEANING

- A. Clean tile and grout surfaces.

### 3.9 PROTECTION

- A. Do not permit installation of toilet accessories, partitions or other items over finished surface for 4 days after installation.
- B. Apply heavy kraft paper to prevent surface damage during construction, and remove before final inspection.

### 3.10 SCHEDULE

- A. See Section 09 05 02 for tile selections
- B. See Section 07 14 10 for waterproofing locations
- C. Accessory use
  1. Use antifracture membrane at all tiled floor locations not waterproofed.
  2. Use non-sanded grout for stainless steel tiles and as recommended by tile manufacturer for tile and joint size.
  3. Use epoxy grout at kitchens, shower floors and walls, Men's toilet room floors, toilet room walls surrounding urinals, any other area subject to regular wetting and at chemical resistant floors.
  4. Use epoxy bond coat at metal substrates, metal tiles, stone or other tile with resin or epoxy backing with or without mesh backing, and at floors or walls requiring chemical resistance.

END OF SECTION

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Linoleum flooring.

**1.2 RELATED REQUIREMENTS**

- A. Section 09 65 00: Resilient Flooring: Comply with requirements of referenced section except as supplemented by work of this section.

**PART 2 PRODUCTS**

**2.1 SHEET FLOORING**

- A. (LN#) Linoleum Sheet Flooring: Homogeneous wear layer bonded to backing, with color and pattern through wear layer thickness:
  - 1. Minimum Requirements: Comply with ASTM F2034, Type corresponding to type specified.
  - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
  - 3. Backing: Jute fabric.
  - 4. Seams: Heat welded.
  - 5. Product: Refer to Section 090502.

**PART 3 EXECUTION - Not Used**

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 SECTION INCLUDES**

- A. Carpet tile, adhered with adhesive squares.
- B. Carpet tile designed for walk off mat.

### **1.2 REFERENCE STANDARDS**

- A. ASTM D 2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2006.
- B. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2008.
- C. CRI 104 - Standard for Installation of Commercial Textile Floorcovering Materials; Carpet and Rug Institute; 2002.
- D. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; current listings at [www.carpet-rug.org](http://www.carpet-rug.org).
- E. CRI (GLC) - Green Label Testing Program - Approved Product Categories for Carpet; Carpet and Rug Institute; current listings at [www.carpet-rug.org](http://www.carpet-rug.org).
- F. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association; 2006.

### **1.3 SUBMITTALS**

- A. Shop Drawings: Indicate layout of joints.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Manufacturer's Installation Instructions: Indicate special procedures.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

### **1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet with minimum three years of experience.

### **1.5 FIELD CONDITIONS**

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

### **1.6 EXTRA MATERIALS**

- A. Provide 50 yds of carpet tiles of each color and pattern selected.

### **1.7 WARRANTY**

- A. 10 year wear and stain

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Provide products listed in Section 09 05 02 Finish Materials Legend.
- B. Carpet Tile: minimum requirements below
  - 1. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E 648 or NFPA 253.
  - 2. Surface Flammability Ignition: Pass ASTM D 2859 (the "pill test").
  - 3. VOC Content: Provide CRI Green Label certified product; in lieu of labeling, independent test report showing compliance is acceptable.
  - 4. Max. Electrostatic Charge: 3 Kv. at 20 percent relative humidity.
  - 5. Manufactured in one color dye lot.

### 2.2 ACCESSORIES

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Rubber, color as selected.
- D. Adhesive Squares: Glue-less Low-VOC installation system designed for modular carpet tiles and to stick to one another, rather than to the floor.
  - 1. Dimensions: Approximately 3 inches square, or manufacturer's recommend size for carpet.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- C. Verify that concrete sub-floor surfaces are ready for carpet tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by carpet tile manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

### 3.2 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.
- D. "Air out" or ventilate carpet offsite for 24 hours minimum prior to delivery to site to reduce on-site off gassing.
  - 1. Or provide certification of no VOCs or offgassing from selected carpet

### 3.3 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Complete installation of edge strips, concealing exposed edges.

#### 3.4 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

**SECTION 20 0000 - GENERAL MECHANICAL REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 REFERENCE**

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

**1.2 DESCRIPTION**

- A. Intent of drawings and Specifications is to obtain complete systems, tested, adjusted, and ready for operation.
- B. Except as otherwise defined in greater detail, the terms "provide", "furnish" and "install" as used in Division 20, 21, 22 and 23 Contract Documents shall have the following meanings:
  - 1. "Provide" or "provided" shall mean "furnish and install".
  - 2. "Furnish" or "furnished" does not include installation.
  - 3. "Install" or "installed" does not include furnishing.
- C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.
- D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with other trades.
- E. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions.
- F. Where Architectural features govern location of work, refer to architectural drawings.
- G. Contractor may install additional piping, fittings and valves, not shown on drawings, for testing purposes or for convenience of installation. Where such materials are installed, they shall comply with specifications and shall be sized to be compatible with system design. Remove such installed materials when they interfere with design conditions or as directed by Owner.

**1.3 RELATED WORK**

- A. Utility Services:
  - 1. Determine utility connection requirements and include in Base Bid all costs to Owner for utility service.
  - 2. Include costs for temporary service, temporary routing of piping or any other requirements of a temporary nature associated with utility service.
- B. Temporary Services:
  - 1. Division 01 - Temporary Facilities and Controls.
- C. Continuity of Service:
  - 1. No service shall be interrupted or changed without permission from Architect and Owner. Obtain written permission before any work is started.
  - 2. When interruption of services is required, Owner, and all other concerned parties shall be notified and shall agree upon a time.

**D. Demolition:**

1. Division 02 - Selective Demolition.
2. Perform demolition as required to accomplish new work.
3. Accomplish work in neat workmanlike manner to minimize interference, annoyance or inconvenience such work might impose on Owner or other Contractors.
4. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
5. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
6. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
7. Where demolition work interferes with Owner's use of premises, schedule work through Architect, Owner and with other Contractors to minimize inconvenience to Owner. Owner must approve schedule before Contractor begins such Work.

**E. Concrete Work:**

1. Provide cast-in-place concrete as required by Contract Documents unless otherwise noted.
2. Concrete shall comply with Division 03 - Concrete.
3. Provide anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of mechanical equipment.

**F. Painting:**

1. Painting of mechanical equipment will be done under Division 09 unless specified otherwise or unless equipment is to be furnished with factory applied finish coats.
2. Furnish equipment with factory applied prime finish unless otherwise specified.
3. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Architect.
4. Furnish one can of touch up paint for each factory-applied coat of product.

**1.4 REQUIREMENTS OF REGULATORY AGENCIES**

- A. Rules and regulations of Federal, State and Local Authorities and utility companies, in force at time of execution of Contract shall become part of this specification.

**1.5 REFERENCE STANDARDS**

A. Agencies or publications referenced herein refer to the following:

1. AGA American Gas Association
2. AMCA Air Movement and Control Association
3. ANSI American National Standards Institute
4. AHRI Air-Conditioning, Heating and Refrigeration Institute
5. ASHRAE American Society of Heating Refrigerating and Air Conditioning Engineers
6. ASPE American Society of Plumbing Engineers
7. ASSE American Society of Sanitary Engineering
8. AWS American Welding Society
9. AWWA American Water Works Association
10. ASME American Society of Mechanical Engineers

- 11. ASTM American Society for Testing and Materials
- 12. CDA Copper Development Association
- 13. CISPI Cast Iron Soil Pipe Institute
- 14. FMG FM Global
- 15. FS Federal Specifications
- 16. IEEE Institute of Electrical and Electronics Engineers
- 17. MCA Mechanical Contractors Association
- 18. MSS Manufacturers Standardization Society
- 19. NEC National Electrical Code
- 20. NEMA National Electrical Manufacturers Association
- 21. NFPA National Fire Protection Association
- 22. NIST National Institute of Standards & Technology
- 23. NSF National Sanitation Foundation
- 24. NSPI National Spa and Pool Institute
- 25. OSHA Occupational Safety and Health Administration
- 26. PDI Plumbing and Drainage Institute
- 27. SMACNA Sheet Metal and Air Conditioning Contractors National Association
- 28. UL Underwriters Laboratories, Inc.
- 29. WQA Water Quality Association

B. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

#### 1.6 SUBMITTALS

##### A. Shop Drawings (Product Data):

- 1. Refer to Division 01 - Submittal Procedures.
- 2. Note that for satisfying submittal requirements for Divisions 20, 21, 22 or 23, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Division 01. However, the expression "Shop Drawings" is generally used throughout Specification.
- 3. Submit shop drawings for equipment and systems as requested in the respective specification sections. Submittals that are not requested may not be reviewed.
- 4. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings. Cross out options and accessories shown on catalog sheets which will not be provided.
- 5. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings. Indicate equipment tag number or specification paragraph number.
- 6. When manufacturer's reference numbers are different from those specified, provide correct cross-reference numbers for each item. Clearly mark and note submittals accordingly.
- 7. Submit complete record of required components when fixtures, equipment and items specified include accessories, parts and additional items under one designation.
- 8. Include composite wiring diagrams, motor efficiency and power factor data for electrically powered equipment and devices.
- 9. Submit equipment room layouts drawn to scale, including equipment, piping, accessories and clearance for maintenance.

10. Where submittals cover products containing non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
  11. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
  12. Submittals that are not complete, not permanent or not properly checked by Contractor will be returned without review. Submittals shall be made in one package per specification section, except information required for record only, e.g. test reports.
  13. Unless specifically requested in Division 20, 21, 22 or 23 technical sections, submittals of coordination drawings will be returned without review.
- B. Certificates and Inspections:**
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.
- C. Operation and Maintenance Manuals:**
1. Refer to Division 01 - Operation and Maintenance Data.
  2. Upon completion of Work but before final acceptance of system, submit to Owner for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than 2" thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit 3 copies to Owner.
  3. Organize manuals by specification section number and furnish table of contents and tabs for each piece of equipment or system.
  4. Fire protection system shall be separately bound.
  5. Manuals shall include the following:
    - a. Copies of Shop Drawings
    - b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
    - c. CD ROM's of O&M data with exploded parts lists where available
    - d. Phone numbers and addresses of local parts suppliers and service companies
    - e. Internet/WEB page addresses where applicable
    - f. Wiring diagrams
    - g. Startup and shutdown procedures
    - h. Composite electrical diagrams
    - i. Flow diagrams
    - j. Lubrication instructions
    - k. Factory and field test records (Refer to Test and Balancing in Part 3 of this section.)
    - l. Air and water balance reports
    - m. Valve identification charts as specified in Section 20 0553 - Mechanical System Identification
    - n. Access panel identification charts as specified in Section 20 0553 - Mechanical System Identification
    - o. Additional information, diagrams or explanations as designated under respective equipment or systems specification sections.
  6. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.

7. Furnish O&M Manuals and instructions to Owner prior to request for final payment.

**D. Record Documents:**

1. Refer to General Conditions of Contract, and Division 01 - Project Record Documents. Prepare complete set of record drawings in accordance with Division 01.

**1.7 JOB CONDITIONS**

**A. Building Access:**

1. Arrange for necessary openings in building to allow for admittance of all apparatus.

**B. Electrical Coordination:**

1. Refer to Section 20 0513 - Motors
2. Contractors for Divisions 20, 21, 22 and 23 shall provide the following items as specified under their respective Division(s) (Division 20, 21, 22 and 23):
  - a. Motors
  - b. Electrically powered equipment
  - c. Electrically controlled equipment
  - d. Starters, where specified
  - e. Variable frequency drives, where specified
  - f. Control devices, where specified
  - g. Temperature Control wiring
  - h. Wiring diagrams to the Contractor for apparatus indicating external connection and internal controls.
  - i. Disconnect devices furnished with units (VFDs, chillers, prepackaged control devices, etc.)
    - 1). Devices shall have an interrupting rating not less than that of the upstream overcurrent device as shown on electrical drawings.
    - 2). Equipment electrical connection points shall be labeled with listed electrical short circuit current rating (SCCR). SCCR shall not be less than interrupting rating of upstream overcurrent device as shown on electrical drawings. SCCR shall be marked on equipment control enclosure in accordance with UL508, or other acceptable, accredited third-party testing agency standards.
3. The Contractor will provide the following devices required for control of motors or electrical equipment, unless noted otherwise.
  - a. Starters
  - b. Disconnect devices
  - c. Control devices:
    - 1). Pushbuttons
    - 2). Pilot lights
    - 3). Contacts
  - d. Conduit, boxes and wiring for power wiring.
  - e. Conduit, boxes and wiring for control wiring, except temperature control wiring.
4. Electrical Contractor will make connections, from power source to starter or variable frequency drive and from starter or variable frequency drive, where specified, to motor for ready to operate.
5. Where starters or other similar control devices are furnished by this contractor, they shall be installed by this contractor and wired by the Contractor.

6. Should any change in size, hp rating, voltage, or means of control be made to any motor or other electrical equipment after Contracts are awarded, this contractor shall immediately notify the Contractor of change. Additional costs due to these changes shall be the responsibility of this contractor.

**C. Cutting and Patching:**

1. Refer to General Conditions of the Contract, and Division 01 - Cutting and Patching.
2. Perform cutting and patching required for complete installation of systems, unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
3. Provide materials required for patching unless otherwise noted.
4. Do not pierce beams or columns without permission of Owner and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.
5. Where alterations disturb lawns, paving, walks, etc., replace, repair or refinish surfaces to condition existing prior to commencement of work. This may include areas beyond construction limits.

**D. Housekeeping and Cleanup:**

1. Refer to Division 01 - Closeout Procedures.
2. As work progresses and/or as directed by Owner, periodically remove waste materials from building and leave area of work broom clean. Upon completion of Work, remove tools, scaffolding, broken and waste materials, etc., from site.

**1.8 WARRANTY**

- A. Refer to Division 01 for general warranty requirements.
- B. Refer to technical sections for warranty requirement for each system.
  1. Where no warranty requirements are called out, warrant equipment, materials, and workmanship to be free from defect for one year after acceptance by Owner.
- C. Warrant that systems will operate without objectionable noise, vibration and uncontrolled expansion.
- D. Repair, replace or alter systems or parts of systems found defective at no extra cost to Owner.
- E. In any case, wherein fulfilling requirements of any warranty, if this contractor disturbs any work warranted under another contract, this contractor shall restore such disturbed work to condition satisfactory to Architect and warranty such restored work to same extent as it was warranted under such other contract.
- F. Warranty shall include labor, materials, and travel time.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. All materials provided shall be asbestos-free.

**2.2 PRODUCT SUBSTITUTIONS**

- A. Refer to Division 01 - Product Requirements.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Verify elevations and dimensions prior to installation of materials.

**3.2 DELIVERY, STORAGE, HANDLING, AND PROTECTION**

- A. Deliver products to the site under provisions of Division 01.
- B. Store and protect products under provisions of Division 01.
- C. Store in clean, dry space.
- D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with manufacturer's written instructions.
- F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.
- G. Protect openings in equipment until connected to system to prevent entry of foreign materials.

**3.3 EXCAVATION AND BACKFILL**

- A. Refer to Division 31 - Earthwork.
- B. Provide excavation and backfill for underground work unless otherwise indicated. Blasting is not allowed on this project without written permission of Architect and Owner.
- C. Backfill trenches beneath concrete floor and stair slabs within building and beneath concrete slabs, walks, stairs and drives at exterior of building with gravel fill and compact to same density as surrounding area.

**3.4 FLOOR, WALL, ROOF AND CEILING OPENINGS**

- A. Coordinate location of openings, chases, furred spaces, etc., with appropriate Contractors. Provide sleeves and inserts that are to be built into structure during progress of construction.
- B. Remove temporary sleeves, if used to form openings, prior to installation of permanent materials. Utilize minimum 24 ga galvanized sheet metal for permanent sleeves unless otherwise noted.
- C. Provide Schedule 40 carbon steel pipe with integral water stop for steel sleeves required in interior floor slabs.
- D. Submit to Structural Engineer for review and approval size and location of core-drilled holes prior to execution.
- E. Submit product data and installation details for penetrations of building structure. Include schedule indicating penetrating materials (metal pipe, plastic pipe, conduit, etc.), sizes of each, opening sizes and sealant products intended for use.
- F. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Section 20 0573 - Mechanical Systems Firestopping.
- G. Submit complete penetration layout drawings showing openings in building structural members including floor slabs, bearing walls, shear walls, etc. Indicate and locate, by dimension, all required openings,

including those sleeved, formed or core drilled. Drawings shall be approved prior to preparing openings in structural member.

- H. Provide minimum 1" clearance around penetration openings intended for pipe. Where fire resistant penetrations are required, size openings in accordance with written recommendations of firestopping systems manufacturer.
- I. Openings for underground pipes passing through foundations or under footings shall have minimum clearance of 1-1/2" to concrete. Do not disturb footing bearing soil.
- J. Openings for underground pipe passing through on grade concrete slabs shall have minimum 1/4" clearance to concrete. Seal openings with urethane caulk.
- K. Openings for insulated piping shall be sized based on outside diameter of insulation when it is specified or detailed to be continuous through opening.
- L. Openings for duct penetrations shall be no more than 1/2" larger on all sides than size of duct or duct including duct insulation, if applicable. Where firestopping systems are required at penetrations, size in accordance with recommendations of firestopping systems manufacturer, but opening shall not exceed 1" average clearance on all sides. Openings for ducts with fire dampers shall be in accordance with fire damper installation requirements.
- M. Duct penetrations through concrete floors in mechanical rooms containing liquid heat exchangers and/or pumps shall have 2" high water stopped curbs surrounding openings. This applies to mechanical rooms above the lowest floor level.
- N. Seal non fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.
- O. Seal non fire-rated wall openings with urethane caulk.
- P. Provide galvanized schedule 40 pipe sleeves at all penetrations through concrete or masonry walls. Coordinate installation with general contractor prior to pour.
- Q. Where penetrations occur through exterior walls into building spaces, use sleeves with integral water stop. For piping having outer surface temperature less than 150°F, use plastic (HDPE) sleeves, similar to PSI Link-Seal Model CS, rated to 150°F. For piping having outer surface temperature 150°F or higher, or where steel sleeves are shown or walls are fire rated, use steel sleeves with hot dip galvanizing, similar to PSI Link-Seal Model WS. Seal annular space between sleeves and pipe with Thunderline "Link-Seal" modular wall and casing seals, or sealing system by another manufacturer approved as equal by Engineer. Where "Link-Seals" are used with insulated pipe, insulation shall be butted against seals on both sides. Sealing system shall utilize Type 316 stainless steel bolts, washers and nuts.
- R. In lieu of openings as specified herein penetration systems as manufactured by Pro Set may be used, including sleeve couplings and plug.
- S. If total Pro Set system with Water Guard "CR" is used, opening shall not need additional water proofing or riser clamps.
- T. Finish and trim penetrations as shown on details and as specified.
- U. Provide chrome or nickel plated escutcheons where piping passes through walls, floors or ceilings and is exposed in finished areas. Size escutcheons to fit pipe and pipe covering for finished appearance. Finished

areas shall not include mechanical/electrical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

- V. Trim duct penetrations exposed in finished areas with 2" wide galvanized or aluminum trim collars properly sized to fit duct. Collars shall be same gauge as duct, prime finish unless noted otherwise. Finished areas shall not include mechanical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

W. In Bio-safety areas if used,

1. Exposed conduit penetrations shall be sealed as follows:
  - a. Escutcheons shall not be used when conduits are exposed in finished areas and penetrate finished surfaces.
  - b. Cut and patch penetration to within 1/4" of conduit.
  - c. Seal openings around conduit and patch work with sealants specified in Division 07 – Joint Sealants. Sealant shall be installed per manufacturer's application requirements.
2. Penetrations other than conduits (junction boxes, light fixtures, etc.) including wiring devices shall be sealed as follows:
  - a. Seal non-rated opening with silicone sealant.
  - b. See Division 26 drawings for details.
  - c. Confirm selected sealant is compatible with paint provided by others prior to application.
  - d. Product: One-Part Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and as applicable to nonporous joint substances indicated, O; formulated with fungicide; intended for sealing interior joints with nonporous substrates and subject to in-service exposure to conditions of high humidity and temperature extremes; subject to compliance with requirements. Provide one of the following:
    - 1). 786 Mildew Resistant Silicone Sealant; Dow Corning Corp.
    - 2). Sanitary 1700 Silicone Sealant; General Electric Co.
    - 3). 898 Silicone Sanitary Sealant; Pecora Corp.
    - 4). Tremsil 600; Tremco Corp.
    - 5). OmniPlus; Sonneborn Building Products Div., Rexnord Chemical Products, Inc.

3.5 EQUIPMENT SHUTOFF VALVES

- A. Provide shutoff valves at equipment connected to piping system. Refer to valve section or system section for requirements of valve type.

3.6 EQUIPMENT ACCESS

- A. Install piping, conduit and accessories to permit access to equipment for maintenance. Relocate piping, equipment or accessories to provide access at no additional cost to Owner.
- B. Install equipment with sufficient maintenance space for removal, repair or changes to equipment. Provide ready accessibility to equipment without moving other future or installed equipment or system components.
- C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors for valves, shock stops or other equipment shall provide access for servicing, repairs, and/or maintenance.
- D. Provide necessary coordination and information to the Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes, and rough-in dimensions.

- E. Provide access doors in walls, chases or above inaccessible ceilings for valves, shock stops, unions or equipment/devices requiring access for servicing, repairs or maintenance, unless otherwise noted. Access frames and doors shall be as manufactured by Milcor, Incorporated, or similar, of style applicable to surface. Provide access doors used in fire rated construction with UL Label. Provide steel, prime coated access doors unless otherwise specified. Provide stainless steel doors in ceramic tile walls, toilet rooms, locker rooms and in areas subject to excessive moisture. Provide access doors of sufficient size to allow complete maintenance. Coordinate location of access doors with General Contractor and rough-in equipment accordingly.

### 3.7 EQUIPMENT SUPPORTS

- A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.
- B. Concrete anchors, used for attachment to concrete, shall be steel shell with plug type. Plastic, rawhide or anchors utilizing lead are not allowed.
- C. Do not support equipment or piping from metal roof decking.

### 3.8 EQUIPMENT GUARDS

- A. Provide equipment guards over belt driven assemblies, pump shafts, exposed fans, and elsewhere as indicated in this Specification or required by Code.
- B. Paint equipment guards bright yellow.
- C. Equipment guards shall comply with OSHA requirements.

### 3.9 SUPPORT PROTECTION

- A. In occupied areas, mechanical rooms and areas requiring normal maintenance access, guard certain equipment to protect personnel from injury.
- B. Provide minimum 1/2" thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment and mechanical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.
- C. Protect threaded rod or bolts at supporting elements as described above. Trim threaded rod or bolts such that they do not extend beyond supporting element.

### 3.10 LEAD SHIELDING

- A. Wherever installation of this Contractor's equipment destroys radiologic integrity of wall, floor, or ceiling, this Contractor shall be responsible to provide suitable lead shielding to restore that integrity. Coordinate these requirements with General Contractor.

### 3.11 MECHANICAL SYSTEMS IDENTIFICATION

- A. Refer to Section 20 0553 - Mechanical Systems Identification

### 3.12 TEST AND BALANCING

- A. Tests for equipment, ductwork and piping systems shall be performed as specified in their respective specification sections in accordance with technical requirements noted.
- B. Provide equipment required for testing, including fittings for additional openings required for test apparatus.

- C. All ductwork and piping inspections and testing shall be successfully completed and approved before application of covering materials.
- D. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or material as necessary and repeat inspection and test until equipment or systems meet test requirements. Make repairs with new materials. Caulking of holes or threaded joints is not allowed.
- E. Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria, test medium and pressure used, duration of test and name and title of person signing test certification document.
- F. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.
- G. Balancing of various systems shall be in accordance with associated specification sections in addition to requirements noted herein.
- H. If exterior domestic water supply also serves as source for fire protection systems, either exterior or interior or both, it shall be tested according to fire protection system requirements as specified in applicable Specification Section.

### 3.13 START-UP

- A. Systems and equipment shall be started, tested, adjusted and turned over to Owner ready for operation. This includes "Owner-Furnished, Contractor-Installed" (OFCI) and "Contractor-Furnished, Contractor-Installed" (CFCI) systems and equipment.
- B. Follow manufacturer's pre-start-up check-out, start-up, trouble shooting and adjustment procedures.
- C. Contractor shall provide services of technician/mechanic knowledgeable in start-up and check-out of types of systems and equipment on project.
- D. Provide start-up services by manufacturer's representative where specified or where Contractor does not have qualified personnel.
- E. Coordinate start-up with all trades.

### 3.14 LUBRICATION

- A. Upon completion of work and before turning over to Owner, clean and lubricate bearings except sealed and permanently lubricated bearings. Use only lubricant recommended by manufacturer.
- B. Contractor is responsible for maintaining lubrication of mechanical equipment under this Contract until Work is accepted by Owner.

### 3.15 CLEANING

- A. Clean systems after installation is complete.
- B. Clean piping and ductwork both internally and externally to remove dirt, plaster dust or other foreign materials. When external surfaces of piping are rusted, clean and restore surface to original condition.
- C. Clean pipeline strainers to restore them to original condition or replace with new strainer elements.
- D. Clean equipment and plumbing fixtures as recommended by manufacturers.

- E. Replace throwaway or replaceable media air filters used during construction period with new filters or new filter media after construction has been completed and before building is turned over to Owner. Filter replacement shall be as hereinafter specified.
- F. Blow and clean dirt, plaster dust and other foreign matter from coils, terminal devices, diffusers, registers and grilles.
- G. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.
- H. Provide additional cleaning of individual piping systems and apparatus as hereinafter specified.

END OF SECTION

**SECTION 22 00 00 - GENERAL PLUMBING REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Specification requirements defined in Division 20 of this Specification apply to, and are in addition to the work associated with equipment, systems, materials, and installation requirements specified in Division 22. Contractor shall provide the requirements specified in Division 20 to obtain complete systems, tested, adjusted, and ready for operation.

**1.2 RELATED WORK**

- A. Section 20 00 00 - General Mechanical Requirements
- B. Section 20 05 13 - Motors
- C. Section 20 05 14 - Variable Frequency Drives
- D. Section 20 05 29 - Mechanical Supporting Devices
- E. Section 20 05 49 - Seismic Anchorage and Restraints
- F. Section 20 05 53 - Mechanical Systems Identification
- G. Section 20 05 73 - Mechanical Systems Firestopping
- H. Section 20 07 00 - Mechanical Systems Insulation

**PART 2 - PRODUCTS**

- 2.1 NOT APPLICABLE TO THIS SECTION.

**PART 3 - EXECUTION**

- 3.1 NOT APPLICABLE TO THIS SECTION.

**END OF SECTION**

## SECTION 26 00 00 - GENERAL ELECTRICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including drawings, Division 00 and Division 01 Requirements.

#### 1.2 DESCRIPTION

- A. Intent of drawings and Specifications is to obtain complete systems tested, adjusted, and ready for operation.
- B. Except as otherwise defined in greater detail, the terms provide, furnish and install as used in Division 26 Contract Documents shall have the following meanings:
  - 1. Provide or provided shall mean furnish and install.
  - 2. Furnish or furnished does not include installation.
  - 3. Install or installed does not include furnishing.
- C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.
- D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with other trades.
- E. Included in this Contract are electrical connections to equipment provided by others. Refer to Architectural, Mechanical, and final shop drawings for equipment being furnished under other sections for exact locations of electrical outlets and various connections required.
- F. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions.
- G. Where architectural features govern location of work, refer to Architectural Drawings.
- H. Work shall be performed in neat and workmanlike manner as defined in ANSI/NECA 1, Standard Practices for Good Workmanship in Electrical Contracting.

#### 1.3 RELATED WORK

- A. Temporary Services:
  - 1. Division 01 – Temporary Facilities and Controls
  - 2. Temporary construction power shall be taken from the Molecular Engineering Building electric room located in the North West area of the basement level, via a grating located at the North end of the building at ground level.
- B. Concrete Work:
  - 1. Provide cast-in-place concrete as required by Contract Documents unless otherwise noted.

2. Concrete shall comply with Division 03 - Concrete.
3. Provide anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of electrical equipment.

**C. Continuity of Service**

1. No service shall be interrupted or changed without permission from the Owner. Obtain written permission before work is started.
2. Where interruption of services is required, the Owner and other concerned parties shall be notified and shall determine a time.

**D. Demolition:**

1. Division 02 – Selective Demolition
2. Perform required demolition to accomplish new work.
  - a. Remove abandoned wiring to source of supply. Wiring and conduit shall be extended where necessary to maintain circuit continuity to areas beyond the demolition scope area.
  - b. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
  - c. Disconnect abandoned outlets and remove devices.
  - d. Remove abandoned outlets if conduit servicing them is abandoned and removed.
  - e. Provide blank cover for abandoned outlets that are not removed.
  - f. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
  - g. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
  - h. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
  - i. Accomplish work in neat workmanlike manner to minimize interference; annoyance or inconvenience such work might impose on Owner or other Contractors.
  - j. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
  - k. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
  - l. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
  - m. Where demolition work interferes with Owner's use of premises, schedule work through Owner and with other Contractors to minimize inconvenience to Owner. Owner must approve schedule before Contractor begins such work.

**E. Cleaning and Repair**

1. Clean and repair existing materials and equipment that remain or is to be reused.
2. Panelboards.
  - a. Clean exposed surfaces and check tightness of electrical connections.
  - b. Replace damaged circuit breakers and provide closure plates for vacant positions.
  - c. Provide typed circuit directory showing revised circuiting arrangement.
3. Luminaires:

- a. Remove existing luminaries for cleaning.
- b. Use mild detergent to clean exterior and interior surfaces; rinse with clean water and wipe dry.
- c. Replace lamps, ballasts, and broken electrical parts.

**F. Painting:**

1. Painting of electrical equipment will be done under Division 09 unless specified otherwise or is to be furnished with factory applied finish coats.
2. Furnish equipment with factory applied prime finish unless otherwise specified.
3. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Owner or Owner's Representative.
4. Furnish 1 can of touch up paint for each factory finish, which will be final finished surface of product.

**1.4 REQUIREMENTS OF REGULATORY AGENCIES**

- A. Rules and regulations of Federal, State and local authorities and utility companies, in force at time of execution of Contract shall become part of this specification.

**1.5 REFERENCE STANDARDS**

**A. Agencies or publications referenced herein refer to the following:**

1. AEIC Association of Edison Illuminating Companies
2. ANSI American National Standards Institute
3. ASME American Society of Mechanical Engineers
4. ASTM American Society for Testing and Materials
5. BICSI Building Industry Consulting Services International
6. EIA Electronic Industries Association
7. FIPS Federal Information Processing Standards
8. FCC Federal Communications Commission
9. ICEA Insulated Cable Engineers Association
10. IEEE Institute of Electrical & Electronics Engineers
11. IESNA Illuminating Engineering Society of North America
12. NEC National Electrical Code
13. NECA National Electrical Contractors Association
14. NEMA National Electrical Manufacturers Association
15. NESC National Electrical Safety Code
16. NETA National Electrical Testing Association
17. NFPA National Fire Protection Association
18. NIST National Institute of Standards & Technology
19. OSHA Occupational Safety and Health Administration
20. TIA Telecommunications Industries Association
21. UL Underwriters Laboratories, Inc.

- B. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

## 1.6 LISTING

- A. Material installed on project shall bear UL label or be UL listed, unless UL label or listing is not available for that type of material.
- B. Other nationally recognized testing agencies, acceptable to AHJ, are approved.

## 1.7 ENCLOSURES

- A. Typical NEMA Enclosures and Usage
  - 1. NEMA 1 - Indoors. Falling dirt.
  - 2. NEMA 2 - Indoors. Falling dirt. Falling liquids. Light splashing.
  - 3. NEMA 3 - Outdoors. Sleet, snow, rain. Windblown dust.
  - 4. NEMA 3X - Same as NEMA 3 plus corrosion resistant.
  - 5. NEMA 3S - Same as NEMA 3 plus mechanism operable when ice covered.
  - 6. NEMA 3SX - Same as NEMA 3S plus corrosion resistant.
  - 7. NEMA 3R - Outdoors. Rain, snow, sleet.
  - 8. NEMA 3RX - Same as NEMA 3R plus corrosion resistant.
  - 9. NEMA 4 - Indoors. Falling dirt. Falling and light splashing liquids. Flying dust, lint and fibers. Hose down.
  - 10. NEMA 4X - Same as NEMA 4 - Indoors plus corrosion resistant.
  - 11. NEMA 4 - Outdoors. Rain, sleet, snow. Wind blown dust. Hose down.
  - 12. NEMA 4X - Same as NEMA 4 - Outdoors plus corrosion resistant.
  - 13. NEMA 5 - Indoors. Falling Dirt. Falling Liquids. Settling dust, lint and fibers.
  - 14. NEMA 6 - Indoors. Falling dirt. Falling and light splashing liquids. Flying dust, lint and fibers. Hose down. Temporary submersion.
  - 15. NEMA 6P - Same as NEMA 6 - Indoors plus corrosion resistant. Prolonged submersion.
  - 16. NEMA 6 - Outdoors. Rain, snow, sleet. Windblown dust. Hose down. Temporary submersion.
  - 17. NEMA 6P - Same as NEMA 6 - Outdoors plus corrosion resistant. Prolonged Submersion.
  - 18. NEMA 7 - Indoors. Class I, Division 1 or 2, Groups A, B, C or D. (Flammable gas).
  - 19. NEMA 9 - Indoors. Class II, Division 1 or 2. Groups E, R, or G. (Combustible dust).
  - 20. NEMA 12 - Indoors. Falling Dirt. Falling liquids. Flying dust, lint and fibers. Oil or coolant seepage.
  - 21. NEMA 13 - Same as NEMA 12 plus oil or coolant spraying or splashing.

## 1.8 SUBMITTALS

- A. Shop Drawings (Product Data):
  - 1. Refer to Division 01 - Submittal Procedures.
  - 2. Note that for satisfying submittal requirements for Division 26, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Division 01. However, the expression "Shop Drawings" is generally used throughout Specification.
  - 3. Submit shop drawings for equipment and systems as requested in respective specification sections. Submittals which are not requested may not be reviewed.
  - 4. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings.

5. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
  6. When manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. Clearly mark and note submittal accordingly.
  7. Include all required components when luminaires, equipment and items specified include accessories, parts and additional items under one designation.
  8. Include wiring diagrams for electrically powered or controlled equipment.
  9. "Coordination Drawings", which are normally prepared by Contractor to coordinate work among various trades and to facilitate installation, shall not be submitted for Division 26 work unless specifically requested in technical sections. These types of drawings typically include dimensioned piping, ductwork or electrical raceway layouts.
  10. Unless specifically requested in Division 26 technical sections, submittals of coordination drawings will be returned without review.
- B. Certificates and Inspections:**
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.
- C. Operation and Maintenance Manuals:**
1. Refer to Division 01 - Operation and Maintenance Data.
  2. Upon completion of work but before final acceptance of system, submit to Architect for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than 2" thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit 3 copies to Owner.
  3. Organize manuals by specification section number and furnish table of contents and tabs for each piece of equipment or system.
  4. Manuals shall include the following:
    - a. Copies of shop drawings
    - b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
    - c. CD ROM's of O&M data with exploded parts lists where available
    - d. Phone numbers and addresses of local parts suppliers and service companies
    - e. Internet/WEB page addresses where applicable
    - f. Wiring diagrams
    - g. Start up and shut down procedure
    - h. Factory and field test records
    - i. Additional information, diagrams or explanations as designated under respective equipment or systems specification section
  5. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
  6. Furnish O&M manuals and instructions to Owner prior to request for final payment.

**D. Record Documents:**

1. Refer to General Conditions of Contract and Division 01 - Project Record Documents. Prepare complete set of record drawings in accordance with Division 01.
2. Use designated set of prints of Contract Documents as prepared by Architect to mark-up for record drawing purposes.

**E. Calculations:**

1. Submit printed results of calculations of short circuit analysis, arc flash analysis, and selective coordination analysis.
2. Submit calculation model and analysis results on CDROM.

**F. Record Documents:**

1. Refer to General Conditions of Contract and Division 01 - Project Record Documents. Prepare complete set of record drawings in accordance with Division 01.
2. Use designated set of prints of Contract Documents as prepared by Architect to mark-up for record drawing purposes.

**1.9 JOB CONDITIONS**

**A. Building Access:**

1. Arrange for necessary openings in building to allow for admittance of all apparatus.

**B. Coordination:**

1. Equipment provided under other Divisions of these specifications.
  - a. Motors
  - b. Electrically powered equipment
  - c. Electrically controlled equipment
  - d. Starters, where specified
  - e. Variable frequency drives
  - f. Control devices, where specified
  - g. Temperature Control wiring
2. This Contractor shall provide, unless noted otherwise:
  - a. Starters
  - b. Disconnect devices
  - c. Control devices:
    - 1). Pushbuttons
    - 2). Pilot lights
    - 3). Contacts
  - d. Power wiring
  - e. Control wiring, except temperature control wiring.
3. Connect and wire equipment complete and ready to operate according to wiring diagrams furnished by various trades.
4. Where starters or other devices are furnished, by others they shall be connected and wired by this Contractor.

5. This Contractor's drawings and/or specifications shall show number and HP rating of motors furnished by others, together with their actuating devices. Should any change in size, HP rating or means of control be made to any motor or other electrical equipment after Contracts are awarded, Contractor responsible for change shall immediately notify this Contractor. Additional costs due to these changes shall be responsibility of Contractor initiating change.
  6. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform. (i.e., general purpose, weatherproof, rain tight, explosion proof, dust tight, or any other special type as required.)
  7. Motors shall be furnished by others for starting in accordance with local utility requirements and shall be compatible with starters as specified herein or under various trade sections of these specifications.
- C. Cutting and Patching:
1. Refer to General Conditions of the Contract and Division 01 - Cutting and Patching.
  2. Perform cutting and patching required for complete installation of systems, unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
  3. Provide materials required for patching unless otherwise noted.
  4. Do not pierce beams or columns without permission of Architect and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.
  5. Where alterations disturb lawns, paving, walks, etc., replace, repair or refinish surfaces to condition existing prior to commencement of work. This may include areas beyond construction limits.
- D. Housekeeping and Cleanup:
1. Refer to Division 01 - Closeout Procedures.
  2. As work progresses or as directed by Architect, periodically remove waste materials from building and leave area of work broom clean. Upon completion of work, remove tools, scaffolding, broken and waste materials, etc. from site.

#### 1.10 WARRANTY

- A. Refer to Division 01 for general warranty requirements.
- B. Refer to technical sections for warranty requirement for each system.
  1. Where no warranty requirements are called out, warrant as called out in Division 01 equipment, materials, and workmanship to be free from defect.
- C. Repair, replace, or alter systems or parts of systems found defective at no extra cost to Owner.
- D. In any case, wherein fulfilling requirements of any guarantee, if this contractor disturbs any work guaranteed under another contract, this contractor shall restore such disturbed work to condition satisfactory to Architect and guarantee such restored work to same extent as it was guaranteed under such other contract.
- E. Warranty shall include labor, material, and travel time.

#### PART 2 - PRODUCTS

## 2.1 PRODUCT SUBSTITUTIONS

- A. Refer to Division 01 – Product Requirements

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Verify elevations and measurements prior to installation of materials.

### 3.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site under provisions of Division 01.
- B. Store and protect products under provisions of Division 01
- C. Store in clean, dry space.
- D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with manufacturer's written instructions.
- F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

### 3.3 FLOOR, WALL, ROOF AND CEILING OPENINGS

- A. Coordinate location of openings, chases, furred spaces, etc. with appropriate Contractors. Provide during progress of construction sleeves and inserts that are to be built into structure.
- B. Temporary sleeves, if used to form wall openings, shall be removed prior to installation of permanent materials. Permanent sleeves for wall penetrations shall be minimum 24 ga galvanized sheet metal unless otherwise noted
- C. Steel sleeves, when required, shall be Schedule 40 carbon steel pipe with integral water stop.
- D. For core drilled holes, size and location shall be reviewed and approved by Structural Engineer prior to execution.
- E. Submit product data and installation details for penetrations of building structure. Submittal shall include schedule indicating penetrating materials, (steel conduit, PVC conduit, cables, cable tray, etc.), sizes of each, opening sizes and sealant products intended for use.
- F. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Section 26 05 93 - Electrical Systems Firestopping.
- G. Submit complete penetration layout drawings showing openings in building structural members including floor slabs, bearing walls, shear walls, etc. Indicate and locate, by dimension, required openings including those sleeved, formed or core drilled. Drawings shall be approved prior to preparing openings in structural member.

- H. Openings for penetrations shall be minimum 1/2" larger on all sides than outside dimensions of raceways or cables. However, where fire resistant penetrations are required, size openings in accordance with recommendations of firestopping systems manufacturer.
- I. Seal non fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.
- J. Seal non-rated wall openings with urethane caulk.
- K. Where penetrations occur through exterior walls into building spaces, use steel sleeves with integral water stop, similar to type "WS" wall sleeves by Thunderline Corporation, APS Innerlynx, or approved equal. Seal annular space between sleeves and pipe with "Link-Seal" modular wall and casing seals by Thunderline Corporation, APS Innerlynx, or approved equal. Sealing system shall utilize Type 316 stainless steel bolts, washers and nuts.
- L. Finish and trim penetrations as shown on details and as specified hereinafter.
- M. Provide chrome or nickel plated escutcheons where raceways pass through walls, floors or ceilings and are exposed in finished areas. Size escutcheons to fit raceways for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitor's closets, storage rooms, etc., unless suspended ceilings are specified.
- N. Penetrations between laboratory and non-laboratory shall be sealed.
  - 1. Escutcheons shall not be used when conduits are exposed in finished areas and penetrate surface of finished walls, ceilings, or floors.
  - 2. Cut and patch penetration to within 1/4" of conduit.

### 3.4 EQUIPMENT ACCESS

- A. Install raceways, junction and pull boxes, and accessories to permit access to equipment for maintenance. Relocation of raceways, or accessories as required, to provide access shall be provided at no additional cost to Owner.
- B. Install equipment with ample space allowed for removal, repair or changes to equipment. Provide ready accessibility to equipment and wiring without moving other equipment, which is to be installed or which is already in place.
- C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors shall be for the purpose of providing access where equipment requiring servicing, repairs or maintenance is located in walls, chases or above inaccessible ceilings.
- D. Provide necessary coordination and information to the Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes and rough-in dimensions, without limitations.
- E. Provide access doors where equipment, requiring access for servicing, repairs and maintenance is located in walls, chases or above inaccessible ceilings, unless otherwise noted. Access frames and doors shall be as manufactured by Milcor, Incorporated, or similar, of style applicable to surface. Access doors used in fire-rated construction shall have UL label. Access doors shall be steel, prime coated, except use stainless steel doors in ceramic tile walls, toilet rooms, locker rooms, and in areas subject to excessive moisture. Access

doors shall be of sufficient size to allow for total maintenance. Location of access doors shall be coordinated with General Contractor and location of equipment shall be roughed in accordingly.

- F. Locate electrical outlets and equipment to fit details, panels, decorating or finish at space. Owner or Owner's Representative reserves right to make minor position changes of outlet locations before work has been installed.
- G. Verify door swings before installing room lighting switch boxes and install boxes on latch side of door unless otherwise noted

### 3.5 EQUIPMENT SUPPORTS

- A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.
- B. Concrete anchors, used for attachment to concrete, shall be steel shell with plug type. Plastic, rawhide or anchors utilizing lead are not allowed.
- C. Do not support equipment or luminaires from metal roof decking.

### 3.6 SUPPORT PROTECTION

- A. In occupied areas, mechanical rooms and areas requiring normal maintenance access, certain equipment must be guarded to protect personnel from injury.
- B. Provide minimum 1/2" thick Armacell Armaflex, K. Flex USA, Aeroflex Model Aerocel on lower edges of equipment, including bus duct, cable tray, pull boxes and electrical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas. Unless noted otherwise, material itself or on a composite basis, shall meet ASTM E-84, UL 723 or NFPA 255 and shall not exceed 25 flame spread and 50 smoke developed.
- C. Threaded rod or bolts shall not extend beyond supporting element and shall be protected as described above.

### 3.7 HOUSEKEEPING PADS

- A. Provide concrete housekeeping floor-mounted equipment.
- B. Pads shall be 3.5" high and be 2" wider and longer than equipment it supports.

### 3.8 SHIELDING]

- A. Wherever installation of this contractor's equipment destroys EMF shielding of wall, floor, or ceiling, this Contractor shall be responsible to provide suitable shielding to restore that integrity. Coordinate these requirements with the General Contractor.

### 3.9 ELECTRICAL SYSTEMS IDENTIFICATION

- A. Refer to Section 26 05 53 – Electrical Systems Identification.

### 3.10 ACCEPTANCE TESTING

- A. Contractor shall engage testing and inspection agency to perform acceptance tests. Equipment to be tested is noted as "Testing by Testing Agency" in technical specification sections. Testing shall be in accordance with Section 26 08 12 – Power Distribution Acceptance Tests.
- B. When testing is to be witnessed by Owner, Owner's Representative or Inspector, notify them at least 10 days prior to testing date.
- C. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or materials as necessary and repeat inspection and test. Make repairs with new materials.
- D. This Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria and name and title of person signing test certification documents.
- E. Maintain copies of certified tests, including those for any failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.

### 3.11 START-UP

- A. Systems and equipment shall be started, tested, adjusted and turned over to Owner ready for operation.
  - 1. This includes "Owner-Furnished, Contractor-Installed" (OFCI) and "Contractor-Furnished, Contractor-Installed" (CFCI) systems and equipment.
- B. Follow manufacturer's pre-start-up checkout, start-up, trouble shooting and adjustment procedures.
- C. Contractor shall provide services of technician/mechanic knowledgeable in start-up and checkout of types of systems and equipment on project.
- D. Provide start-up services, by manufacturer's representative where specified or where Contractor does not have qualified personnel.
- E. Coordinate start-up with all trades.

### 3.12 CLEANING

- A. After installation is complete, Contractor shall clean all systems.
- B. Vacuum debris from transformers, panelboards, switchboards, motor starter and disconnect switch enclosures, junction boxes and pull boxes two weeks before energization and again prior to completion.
- C. Where louvers are provided in switchgear or transformer enclosures, vacuum louvers free of dust and dirt.
- D. Clean luminaire lenses and lamps at time of installation and clean lens exteriors just prior to final inspection.
- E. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

END OF SECTION