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FAX TRANSMITTAL

Date: November 29, 2016

To: Plan Holders

Company: Contractors

Number of Pages: ~~89~~ **84** (Including Cover)

From: Krista Smith
– Contract Administration
– Telephone No. 918.596.9406
– Fax No. 918.699.3640
– Email – ksmith@cityoftulsa.org

RE: Project No.:

145620
GILCREASE LIBRARY ARCHIVAL STORAGE

ADDENDUM NO. 1

**This information must be picked up at
2317 S. Jackson, Room N103**

Please fax or email a signed cover sheet to 918.699.3640 or
ksmith@cityoftulsa.org as acknowledgement of receipt.

Thank you,

Krista Smith

Signature

Company

Date

November 21, 2016

**ADDENDUM NO. 1
TO
PROJECT NO. 145620
GILCREASE LIBRARY ARCHIVAL STORAGE**

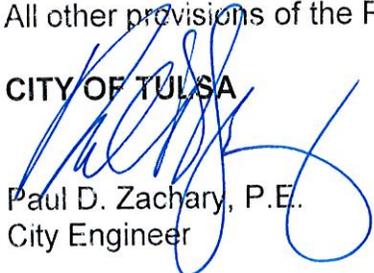
This Addendum No. 1 consisting of sixteen (16) items and six (6) clarifications, submitted by Selser Schaefer Architects, and one (1) item submitted by the City of Tulsa, is hereby made a part of the Contract Documents to the same extent as though it were originally included therein, and shall supersede anything contained in the Plans and Specifications with which it might conflict. **This Addendum shall be attached to the Index Sheet of the Contract Documents and submitted with bid. Failure to do so shall result in the bid being deemed non-responsive.**

This Addendum No. 1 consists of the following:

1. In the Specifications Book the Notice to Bidders and Index state the City of Tulsa SBE program to be utilized on this Project; the attached SBE documents are the required documents and shall apply to this project.

All other provisions of the Plans and Specifications shall remain in full force and effect.

CITY OF TULSA



Paul D. Zachary, P.E.
City Engineer

PEB
HAS/MAH/PEB/peb

17 November 2016

SELSER SCHAEFER ARCHITECTS

Addendum 1 to the Bidding Documents for:

Gilcrease Library Archival Storage
1400 North Gilcrease Museum Road
Tulsa, Oklahoma 74127

Project Number 145620

Project Manual Issue 01; dated 15 August 2016
Drawings Issue 01; dated 15 August 2016

The contents of this Addendum 1 supersede and supplement all portions of the above referenced bidding documents (*including project manual and all associated drawing sets*) with which Addendum 1 conflicts.

PROJECT MANUAL

SECTION 00 0010 – TABLE OF CONTENTS

- Item 1 Remove Section 21 1313 – WET-PIPE SPRINKLER SYSTEMS.
- Item 2 Add Section 21 1316 – DRY-PIPE SPRINKLER SYSTEMS.
- Item 3 Add Section 21 2200 – CLEAN AGENT FIRE-EXTINGUISHER SYSTEMS.

SECTION 01 1000 – SUMMARY

- Item 1 Remove item 1.2.A.7.
- Item 2 Modify On-Site Work Hours as listed in 1.7.B.
- Item 3 Modify On-Site Non-Work Days/Times as listed in 1.7.C.

SECTION 03 3516 – CONCRETE TOPPING

- Item 1 Modify 2.1.A.1 product to be Ardex SD-T.
- Item 2 Add items 2.2.C and 3.7 to clarify inclusion of sealer product.
- Item 3 Modify 3.3.A to allow use of an electric motor, automatic mixing pump.

SECTION 09 8123 – INTERIOR PAINTING

- Item 1 Add sealer product for existing spray-applied fire proofing.

SECTION 21 1313 – WET-PIPE SPRINKLER SYSTEMS

- Item 1 Remove section in its entirety.

SECTION 21 1316 – DRY-PIPE SPRINKLER SYSTEMS

- Item 1 Add section in its entirety.

SECTION 21 2200 – CLEAN AGENT FIRE-EXTINGUISHER SYSTEMS

- Item 1 Add section in its entirety.

SECTION 23 0900 – INSTRUMENTATION AND CONTROL FOR HVAC

- Item 1 Johnson Controls Inc. (JCI) shall replace Automated Building Systems (ABS).

SECTION 23 3300 – AIR DUCT ACCESSORIES

- Item 1 Add Pottorff to acceptable manufacturers in Article/Paragraph 2.3.A.1.f.
- Item 2 Add Pottorff to acceptable manufacturers in Article/Paragraph 2.4.A.7.
- Item 3 Add Pottorff to acceptable manufacturers in Article/Paragraph 2.5.A.6.

CLARIFICATIONS

- Item CL 1.1** 03 3520 – SPECIAL CONCRETE FINISHES. Does this section apply to all rooms scheduled as “sealed concrete?”
Response: Yes - This section applies to all rooms scheduled as “sealed concrete.”
- Item CL 1.2** 03 3516 – CONCRETE FLOOR TOPPING. Verify installation procedures are OK for interiors-only (hand mixing only or small inside mixer).
Response: Portable electric mixers or mixing pumps are allowed inside for the mixing and distribution of the product.
- Item CL 1.3** Are existing fire alarm devices to be reused on this project?
Response: Yes - It shall be acceptable to reuse existing fire alarm devices on this project provided that devices are fully operational and comply with all applicable codes.
- Item CL 1.4** Wiring for the releasing portion of the Novec fire extinguishing system required to be installed in conduit per NFPA 2001. Will this be provided by the Electrical Contractor?
Response: Wiring provided by the Fire Alarm Contractor.
- Item CL 1.5** Will power be provided by the Electrical Contractor?
Response: Power provided by Electrical Contractor.
- Item CL 1.6** Will the Electrical Contractor be responsible for the power to the smoke dampers?
Response: Electrical Contractor shall be responsible for power to the smoke dampers.

DRAWINGS

ARCHITECTURAL

C1/G002 – PAY ITEM SCHEDULE

- Item 1 Update Spec No. of Item #9, Finish Flooring: Sealed Concrete to be 033520 to match specification.

A4/A001 – ROOM FINISH SCHEDULE

- Item 1 Revise ceiling in ROOM 208, DIGITALIZATION ROOM to be ACT, height to be 9'-0”.

A2/A121 – REFLECTED CEILING PLAN

- Item 1 Add two (2) recessed can light fixtures in Corridor 201.

C5/A121 – RCP LEGEND

- Item 1 Add recessed can light fixture.

MECHANICAL

M501 – MECHANICAL SCHEDULES

- Item 1 Refer to attached MSK-01 containing ELECTRIC DUCT HEATER SCHEDULE and revise as indicated.

ELECTRICAL

E003 – FIXTURE SCHEDULE

- Item 1 Refer to attached sheet E003 and revise as indicated.

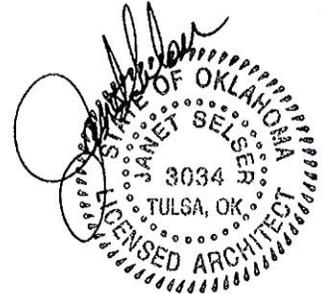
E101 – LIGHT PLAN

- Item 1 Subject to compliance with Construction Documents, the Cooper-Halo LED track fixture Type "I" is approved for bidding. Fixture manufacturer is responsible for providing fixtures that meet the design requirements.
- Item 2 Refer to attached sheet E101 and revise as indicated.

ATTACHMENTS:

- SECTION 00 0010 – TABLE OF CONTENTS
- SECTION 01 1000 – SUMMARY
- SECTION 03 3516 – CONCRETE TOPPING
- SECTION 09 9123 – INTERIOR PAINTING
- SECTION 21 1316 – DRY-PIPE SPRINKLER SYSTEMS
- SECTION 21 2200 – CLEAN AGENT FIRE-EXTINGUISHER SYSTEMS
- SECTION 23 0900 – INSTRUMENTATION AND CONTROL FOR HVAC
- SECTION 23 3300 – AIR DUCT ACCESSORIES
- A001 – SCHEDULES AND FRAME TYPES
- A121 – REFLECTED CEILING PLAN
- MSK-01 – ELECTRIC DUCT HEATER SCHEDULE
- E003 – FIXTURE SCHEDULE
- E101 – LIGHT PLAN

END OF ADDENDUM 1



11/17/2016

DOCUMENT 00 0010 – TABLE OF CONTENTS

DIVISION 0 – BIDDING REQUIREMENTS AND CONTRACT FORMS

- 00 0001 PROJECT DIRECTORY
- 00 0003 SPECIFICATION INDEX LIST
- 00 0010 TABLE OF CONTENTS
- 00 0702 SUPPLEMENTARY CONDITIONS

DIVISION 1 – GENERAL REQUIREMENTS

- 01 1000 SUMMARY
- 01 2200 UNIT PRICES
- 01 2300 ALTERNATES
- 01 2500 SUBSTITUTION PROCEDURES
Substitution Request Form
- 01 2600 CONTRACT MODIFICATION PROCEDURES
- 01 3100 PROJECT MANAGEMENT AND COORDINATION
Request for Interpretation Form
- 01 3200 CONSTRUCTION PROGRESS DOCUMENTATION
- 01 3233 PHOTOGRAPHIC DOCUMENTATION
- 01 3300 SUBMITTAL PROCEDURES
Letter of Compliance
Digital File Release Form
- 01 4000 QUALITY REQUIREMENTS
- 01 4200 REFERENCES
- 01 5000 TEMPORARY FACILITIES AND CONTROLS
- 01 6000 PRODUCT REQUIREMENTS
- 01 7300 EXECUTION
- 01 7700 CLOSEOUT PROCEDURES
- 01 7823 OPERATION AND MAINTENANCE DATA
- 01 7839 PROJECT RECORD DOCUMENTS
- 01 7900 DEMONSTRATION AND TRAINING

DIVISION 2 – EXISTING CONDITIONS

- 02 4119 SELECTIVE STRUCTURE DEMOLITION

DIVISION 3 – CONCRETE

- 03 3516 CONCRETE TOPPING
- 03 3520 SPECIAL CONCRETE FINISHES

DIVISION 5 – METALS

- 05 5000 METAL FABRICATIONS

DIVISION 6 – WOOD, PLASTICS AND COMPOSITES

- 06 1000 ROUGH CARPENTRY
- 06 4023 INTERIOR ARCHITECTURAL WOODWORK

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

- 07 8413 PENETRATION FIRESTOPPING
- 07 9200 JOINT SEALANTS

DIVISION 8 – OPENINGS

- 08 1113 HOLLOW METAL DOORS AND FRAMES
- 08 1416 FLUSH WOOD DOORS
- 08 4113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
- 08 7100 DOOR HARDWARE
Hardware Schedule

08 8800 GLAZING

DIVISION 9 – FINISHES

09 2216 NON-STRUCTURAL METAL FRAMING
09 2900 WALLBOARD
09 5113 ACOUSTICAL PANEL CEILINGS
09 6513 RESILIENT BASE AND ACCESSORIES
09 7290 TACKABLE WALL COVERING
09 9123 INTERIOR PAINTING
09 9313 STAINING AND TRANSPARENT FINISHING
09 9646 INTUMESCENT PAINTING

DIVISION 10 – SPECIALTIES

10 2600 CORNER GUARDS
10 4413 FIRE PROTECTION CABINETS AND ACCESSORIES
10 4416 FIRE EXTINGUISHERS

DIVISION 21 – FIRE SUPPRESSION

21 0517 SLEEVES & SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING
21 0518 ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING
21 0553 IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
21 1313 WET-PIPE SPRINKLER SYSTEMS

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

23 0529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 0553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 0593 TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 0713 DUCT INSULATION
23 0900 INSTRUMENTATION AND CONTROL FOR HVAC
23 3113 METAL DUCTS
23 3300 AIR DUCT ACCESSORIES
23 3713 DIFFUSERS, REGISTERS, AND GRILLES

DIVISION 26 – ELECTRICAL

26 0500 COMMON WORK RESULTS FOR ELECTRICAL
26 0519 CONDUCTORS AND CABLES
26 0526 GROUNDING AND BONDING
26 0533 RACEWAYS AND BOXES
26 0553 ELECTRICAL IDENTIFICATION
26 0923 LIGHTING CONTROL DEVICES
26 2416 PANELBOARDS
26 2726 WIRING DEVICES
26 2813 FUSES
26 2816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 4313 TRANSIENT VOLTAGE SUPPRESSION
26 5100 INTERIOR LIGHTING

END OF SECTION 00 0010

SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Access to site.
 - 4. Coordination with occupants.
 - 5. Work restrictions.
 - 6. Specification and drawing conventions.
- B. Related Requirements:
 - 1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Gilcrease Museum Library / Archival Storage. Project Number 145620.
 - 1. Project Location: 1400 North Gilcrease Museum Road, Tulsa, Oklahoma 74127.
- B. Contract Documents dated 15 August, 2016 were prepared by Selser Schaefer Architects and include the following:
 - 1. Project Manual: Issue 01.
 - 2. Drawing Set: Issue 01.
- C. Owner: City of Tulsa, Oklahoma.
 - 1. Owner's Representative: Max Wells, Project Manager.
- D. Project Information Management Software: Project Information Management Software administered by Architect will be used for purposes of managing communication and transferring documents during the construction stage.
 - 1. See Division 01 Section "Project Management and Coordination" for requirements for using the software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Construction Contract Documents.
 - 1. The Contract Documents are complimentary, and what is required by one shall be as binding as required by all. In the event of conflict between the Specifications and the Drawings, the Specifications shall take precedence; in the event of conflict between Drawings, the more detailed drawing shall take precedence over floor plans, building sections, and drawings of lesser detail.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.5 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to area being remodeled, access pathway from site storage to construction zone and Brannin parking lot, lower level.
 - 2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to working hours of 7:00AM to 5:00PM, daily, unless otherwise indicated.
 - 1. Hours for Utility Shutdowns: Notify Owner's representative not less than two days in advance of proposed disruptive operations.
- C. On-Site Non-Work Days/Times: Owner has supplied a list of dates and times that special events may be affected by construction noise. These dates are as follows:
 - 1. Friday, December 22, 2016 – Wedding in HCAR at 5:00 p.m. Construction should conclude by 5:00p.m.
 - 2. Saturday, January 7, 2017 – Wedding in HCAR at 10:00 a.m.
 - 3. Friday, January 13, 2017 – Plains Indian Art Lecture – HCAR.
 - 4. Friday, January 20, 2017 – Plains Indian Exhibition Lecture – HCAR.
 - 5. February 10-12, 2017 – Plains Indian Opening Weekend – HCAR/Museum.
 - 6. Saturday, March 4, 2017 – Early American Conference in HCAR – All Day.
 - 7. March/April, 2017 – Date to be determined – CM Russell Symposium – HCAR.
 - 8. Saturday, April 8, 2017 – Wedding in Victorian Gardens.

9. Notify Owner's construction representative and Sandra Freeman, Director of Operations, Secretary to the Gilcrease National Board, not less than two days in advance of proposed disruptive operations.
- D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify Director of Operations not less than two days in advance of proposed utility interruptions.
 2. Obtain Director of Operations written permission before proceeding with utility interruptions.
 - A. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Director of Operations.
 - B. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
 - C. Controlled Substances: Use of tobacco products and other controlled substances within the existing building is not permitted.
 - D. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
 - E. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 1. Maintain list of approved screened personnel with Owner's representative.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products may be identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 03 3516 - CONCRETE TOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Self-leveling, quick setting concrete floor topping.

1.2 INFORMATIONAL SUBMITTALS

- A. Letter of Compliance: Submit one completed Letter of Compliance for each product/system indicated within this Section.

PART 2 - PRODUCTS

2.1 CONCRETE FLOOR TOPPINGS

- A. Concrete Floor Topping: Factory-prepared and dry-packaged mixture of portland cement, and polymers to which only water needs to be added at Project site.
 - 1. Product: Provide Ardex SD-T by Ardex Engineered Cements, or an equal product by one of the following manufacturers:
 - a. BASF Construction Chemicals.
 - b. Euclid Chemical Company.

2.2 RELATED MATERIALS

- A. Water: Potable.
- B. Primer: Ardex P 51 or comparable product as recommended by manufacturer.
- C. Sealer: Ardex CG or comparable product as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Existing Concrete: Remove existing surface treatments and deteriorated and unsound concrete. Mechanically abrade base slabs to produce a heavily scarified surface profile with an amplitude not greater than 1 ½".
 - 1. Prepare and clean existing base slabs according to concrete floor topping manufacturer's written instructions. Fill voids, cracks, and cavities in base slabs. Follow manufacturer's recommendations with regards to treatment of joints.

3.2 PRIMER APPLICATION

- A. Apply evenly with soft bristled push broom filling all bare spots. Do not use rollers, mops or spray equipment. Brush off puddles and excess primer.
- B. Allow primer to dry to a thin clear film.

3.3 FLOOR TOPPING MIXING AND APPLICATION

- A. Pour water into a mixing drum or an electric powered, automatic mixing pump that is designed for floor topping applications. Add dry pre-packaged leveling product while mixing. Mix thoroughly two to three minutes to obtain a lump free mixture. Follow manufacturer's written recommendations for mixing and delivering the mixture to the application location.
- B. Pour mix onto floor and spread according to manufacturer's written recommendations.

3.4 PROTECTING AND CURING

- A. Do not walk on floor topping until initial set.

3.5 JOINT FILLING

- A. Prepare and clean construction joints and install semi-rigid joint filler, according to manufacturer's written instructions, once topping has fully cured.
- B. Install semi-rigid joint filler full depth of contraction joints. Overfill joint and trim semirigid joint filler flush with top of joint after hardening.

3.6 REPAIRS

- A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.

3.7 SEALER

- A. Apply sealer according to manufacturer's written recommendations.

END OF SECTION 03 3516

SECTION 09 9123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
1. Steel.
 2. Galvanized metal.
 3. Wood.
 4. Gypsum board.
 5. Sprayed Fire Proofing.
- B. Paint exposed surfaces except where paint schedules indicate that a surface or material is not to be painted or is to remain natural. If paint schedules do not specifically mention an item or surface, paint the item or surface the same as similar adjacent surfaces whether or not schedules indicate colors. If schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces or mechanical and electrical equipment.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, or labels.
1. Prefinished items include the following factory-finished components:
 - a. Finished mechanical and electrical equipment.
 - b. Light fixtures.
 - c. Glass.
 - d. Sealants.
 - e. Veneer masonry and stone.
 - f. Carpeting and VCT.
 - g. Chain link fencing.
 - h. Toilet enclosures.
 2. Concealed surfaces include walls or ceilings in the following generally inaccessible areas:
 - a. Furred areas.
 - b. Ceiling plenums.
 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper, bronze and brass.
 - e. Factory-applied fluorocarbon and powder coated metal.
 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operations.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code required labels or equipment names, identification, performance rating, or nomenclature plates.
 6. Surfaces scheduled to receive multi-color coating.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.

1.3 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Acceptable Manufacturers:
 - 1. Benjamin Moore & Company.
 - 2. ICI Paints.
 - 3. PPG Industries.
 - 4. Pratt & Lambert Paints.
 - 5. Sherwin Williams Company.
- C. Colors: Refer to Interior Finish Legend and Schedule.

2.2 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.
 - 1. Water based latex sealer used on interior plaster, concrete and gypsum wallboard surfaces. Topcoat with latex or alkyd based paint.
 - 2. VOC Content: E Range of E2.
 - 3. Environmental Performance Rating: EPR 2.

- B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.3 METAL PRIMERS

- A. Quick-Drying Alkyd Metal Primer: MPI #76.
 - 1. Solvent based, modified alkyd, fast drying, anti-corrosive primer for cleaned interior and exterior steel. Topcoat with alkyd based paint.
 - 2. VOC Content: E Range of E2.
- B. Waterborne Galvanized-Metal Primer: MPI #134.
 - 1. Water based metal primer, composed of anti-corrosive pigments and acrylic resins, for cleaned/etched galvanized metal. Topcoat with latex based paint.
 - 2. VOC Content: E Range of E3.
 - 3. Environmental Performance Rating: EPR 3.

2.4 WOOD PRIMERS

- A. Interior Latex-Based Wood Primer: MPI #39.
 - 1. Latex based primer for use on interior wood surfaces such as doors, casings, and trim. Topcoat with latex based paint.
 - 2. VOC Content: E Range of E2.
 - 3. Environmental Performance Rating: EPR 2.

2.5 LATEX PAINTS

- A. Interior Latex (Flat): MPI #53 (Gloss Level 1).
 - 1. Water based latex paint with a flat finish for use on gypsum board ceilings.
 - 2. VOC Content: E Range of E3.
 - 3. Environmental Performance Rating: EPR 2.5.
- B. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).
 - 1. Water based latex-based paint with a finish between a high side sheen flat and a 'satin-like' finish or a low semi-gloss. Use on primed/sealed interior masonry, plaster and gypsum board walls.
 - 2. VOC Content: E Range of E3.
 - 3. Environmental Performance Rating: EPR 3.
- C. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).
 - 1. Water based latex-based paint with a semi-gloss finish. Use on primed/sealed interior wood and metal trim and doors and plaster.
 - 2. Use anti-microbial paint on gypsum wallboard at kitchen, bathroom, and janitor room walls and ceilings.
 - 3. VOC Content: E Range of E2.
 - 4. Environmental Performance Rating: EPR 3.

2.6 ALKYD PAINTS

- A. Interior Alkyd (Gloss): MPI #48 (Gloss Level 6).
 - 1. Solvent based, gloss alkyd paint for primed interior wood and metal surfaces. Primarily used on trim, doors and frames.

2. VOC Content: E Range of E2.

2.7 DRY FOG/FALL COATINGS

- A. Interior Alkyd Dry Fog/Fall: MPI #55.
 1. Solvent based, fast-setting, alkyd interior paint. For metal ceiling surfaces.
 2. VOC Content: E Range of E2.

2.8 FIREPROOFING SEALERS

- A. Water Based Surface Sealer.
 1. Manufacturer: Isolatek International
 2. Transparent-drying, water-dispersible, tinted protective coating. For existing fireproofing applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Wood: 15 percent.
 2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Paint hollow metal frame stops with finish color prior to glazing of windows.

- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Conduits and junction boxes.
 - d. Electrical equipment that is indicated to have a factory-primed finish for field painting.

- F. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

- G. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
 - 1. Alkyd Dry-Fall System: MPI INT 5.1D.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Topcoat: Interior alkyd dry fog/fall.
 - 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (gloss).

- B. Galvanized-Metal Substrates:
 - 1. Latex System: MPI INT 5.3A.
 - a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (eggshell).

- C. Dressed Lumber Substrates: Including architectural woodwork.
 - 1. Latex System: MPI INT 6.3T.
 - a. Prime Coat: Interior latex-based wood primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (semigloss).

- D. Wood Panel Substrates: Including medium-density fiberboard.
 - 1. Latex System: MPI INT 6.4R.
 - a. Prime Coat: Interior latex-based wood primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (semigloss).

E. Gypsum Board Substrates:

1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (flat) (eggshell) (semigloss).

END OF SECTION 09 9123

SECTION 21 1316

DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Sprinkler specialty pipe fittings.
 - 4. Sprinklers.
 - 5. Alarm devices.
 - 6. Manual control stations.
 - 7. Pressure gages.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.
- B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.
- C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.
- D. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve

in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications: According to NFPA 13 unless otherwise indicated:
 - a. Anthro Office Areas (Room 201-210): Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design: According to NFPA 13 unless otherwise indicated.
 - 4. Maximum Protection Area per Sprinkler: According to NFPA 13 unless otherwise indicated.
 - 5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated.
- D. Seismic Performance: Where applicable, sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Plumbing Systems including piping.
 - 2. Mechanical Systems including ductwork and piping.

3. Items penetrating finished ceiling including the following:

- a. Lighting fixtures.
- b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and professional engineer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Fire-hydrant flow test report.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

F. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

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

- 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.10 QUALITY ASSURANCE

A. Installer Qualifications:

- 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

- a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

- 1. NFPA 13, "Installation of Sprinkler Systems."

- D. Sprinkler equipment and installation to be approved by authorities having jurisdiction.
- E. State certified sprinkler contractor shall have a minimum of five years specialized experience in sprinkler system design and installation. The project foreman shall have a minimum of three years experience in the installation of sprinkler systems.

1.11 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Galvanized, Steel Couplings: ASTM A 865, threaded.
- D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME B16.1, Class 125.
- G. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 1. Valves shall be UL listed or FM approved.
 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig .
 3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.
- B. Ball Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 2. Standard: UL 1091 except with ball instead of disc.
 3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 5. Valves NPS 3: Ductile-iron body with grooved ends.
- C. Iron Butterfly Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Global Safety Products, Inc.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 2. Standard: UL 1091.
 3. Pressure Rating: 175 psig.
 4. Body Material: Cast or ductile iron.
 5. Style: Lug or wafer.
 6. End Connections: Grooved.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Fire-End & Croker Corporation.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Metraflex, Inc.
 - g. NIBCO INC.
 - h. Potter Roemer.
 - i. Reliable Automatic Sprinkler Co., Inc.
 - j. Tyco Fire & Building Products LP.
 - k. Victaulic Company.
 - l. Viking Corporation.
 - m. Watts Water Technologies, Inc.
2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

E. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

F. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Mueller Co.; Water Products Division.
 - f. NIBCO INC.
 - g. Tyco Fire & Building Products LP.
 - h. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.

4. Body Material: Cast or ductile iron.
 5. End Connections: Flanged or grooved.
- G. Indicating-Type Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Global Safety Products, Inc.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 2. Standard: UL 1091.
 3. Pressure Rating: 175 psig minimum.
 4. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 5. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
 6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch visual indicating device.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
 - b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Deluge Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 260.
3. Design: Hydraulically operated, differential-pressure type.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
5. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
6. Air Compressor:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc,
 - 3) Viking Corporation.
 - b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - c. Motor Horsepower: Fractional.
 - d. Power: 120-V ac, 60 Hz, single phase.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

- A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.
- B. Flow Detection and Test Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.
- C. Sprinkler Inspector's Test Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Triple R Specialty.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with sight glass.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Reliable Automatic Sprinkler Co., Inc.
 - 2. Tyco Fire & Building Products LP.
 - 3. Viking Corporation.
- B. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
 - 3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
 - 4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Nonresidential Applications: UL 199.
 - 2. Residential Applications: UL 1626.
 - 3. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
 - 1. Chrome plated.
 - 2. Bronze.
 - 3. Painted.
- E. Special Coatings:
 - 1. Wax.
 - 2. Lead.
 - 3. Corrosion-resistant paint.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
 - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Pressure Switches:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Electric Signal Company.
 - b. Tyco Fire & Building Products LP.
 - c. United Electric Controls Co.
 - d. Viking Corporation.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised water-flow switch with retard feature.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design Operation: Rising pressure signals water flow.
- C. Valve Supervisory Switches:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.

- d. System Sensor; a Honeywell company.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled valve is in other than fully open position.
- D. Indicator-Post Supervisory Switches:
- 1. Manufacturers: Subject to compliance with requirements, Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.10 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AMETEK; U.S. Gauge Division.
 - 2. Ashcroft, Inc.
 - 3. Brecco Corporation.
 - 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
- J. Connect air compressor to the following piping and wiring:
 - 1. Pressure gages and controls.
 - 2. Electrical power system.
 - 3. Fire-alarm devices, including low-pressure alarm.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Drain dry-pipe sprinkler piping.
- O. Pressurize and check dry-pipe sprinkler system piping and air compressor.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 0517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 0517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 0518 "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air supply piping.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.8 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.10 PIPING SCHEDULE

- A. Standard-pressure, dry-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
 - 1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- B. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:
 - 1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- C. Standard-pressure, dry-pipe sprinkler system, NPS 5 and larger, shall be the following:
 - 1. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Recessed sprinklers.
 - 3. Rooms with Gypsum board Ceilings: Concealed sprinklers.
 - 4. Wall Mounting: Sidewall sprinklers.
 - 5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - 2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

3. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 1316

SECTION 21 2200 - CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Piping and piping specialties.
2. Extinguishing-agent containers.
3. Extinguishing agent.
4. Detection and alarm devices.
5. Control and alarm panels.
6. Accessories.
7. Connection devices for and wiring between system components.
8. Connection devices for power and integration into building's fire-alarm system.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. EPO: Emergency Power Off.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For clean-agent fire-extinguishing system signed and sealed by a qualified professional engineer.
 1. Include plans, elevations, sections, details, and attachments to other work.
 2. Include design calculations.
 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For clean-agent fire-extinguishing system signed and sealed by the qualified professional engineer.
 1. Indicate compliance with performance requirements and design criteria, including analysis data.

2. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.
 3. Indicate the Following on Reflected Ceiling Plans:
 - a. Ceiling penetrations and ceiling-mounted items.
 - b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.
 - c. Method of attaching hangers to building structure.
 - d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
 4. Indicate the Following on Occupied Work Area Plans:
 - a. Controls and alarms.
 - b. Extinguishing-agent containers, piping and discharge nozzles if mounted in space, detectors, and accessories.
 - c. Equipment and furnishings.
 5. Indicate the Following on Ceiling Plans:
 - a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
 - b. Method of supporting piping.
 - c. Other equipment located in the ceiling space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Domestic water piping.
 2. Items Penetrating Finished Ceiling Include the Following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- E. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For special agent system to include in emergency, operation, and maintenance manuals.
- 1.5 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - B. FM Global Compliance: Provide components that are FM Approved and that are listed in FM Global's "Approval Guide."
 - C. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
1. Detection Devices: Not less than 20 percent of amount of each type installed.
 2. Container Valves: Not less than 10 percent of amount of each size and type installed.
 3. Nozzles: Not less than 20 percent of amount of each type installed.
 4. Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

PART 2 - PRODUCTS

2.1 CLEAN-AGENT SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide SEVO Systems with a FORCE500 addressable detection and control system or comparable product by one of the following:
1. Ansul Incorporated.
 2. Chemetron Fire Systems; a UTC Fire & Security company.
 3. Siemens Building Technologies, Inc.; Fire Safety Division.
 4. Fike Corporation.
- B. Description: Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including the room cavity above the ceiling and below the ceiling.
- C. Delegated Design: Design clean-agent fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, and C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.
- D. Performance Requirements: Discharge FK-5-1-12 within 10 seconds and maintain 6.6 percent concentration by volume at 70 deg F for 10-minute holding time in hazard areas.
1. FK-5-1-12 concentration in hazard areas greater than 10.0 percent immediately after discharge or less than 6.5 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
 2. System Capabilities: Minimum 620-psig calculated working pressure and 360-psig initial charging pressure.
- E. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.
- F. System Operating Sequence: System shall be cross-zoned, ionization detectors and photoelectric detectors reporting to a fully programmable microprocessor-based control panel programmed to operate as follows:
1. Actuating First Detector: Mild audible and visual indication on panel. Strobe lights flash slowly in the protected area.

2. Actuating Second Detector (of opposite type, i.e. ionization or photoelectric): Strong audible and visual indication on panel. Energize horn(s), bell(s), and strobe light(s) in the protected area and outside entry doors. Shut down air-conditioning and ventilating systems serving the protected area, and close doors in the protected area. Send signal to fire-alarm system, initiate 30-second time delay for extinguishing-agent discharge, and discharge extinguishing agent. At agent discharge, terminate power to equipment in the protected area, and release preaction valve to allow water flow to sprinkler system.
- G. Manual stations shall immediately discharge extinguishing agent when activated.
 - H. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will re-initiate 30-second time delay for extinguishing-agent discharge, and discharge extinguishing agent.
 - I. EPO: Will terminate power to protected equipment immediately on actuation.
 - J. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.
 - K. Power Transfer Switch: Transfer from normal to stand-by power source.

2.2 PIPING MATERIALS

- A. See "FK-5-1-12 Agent Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

2.3 PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106/A 106M, Grade A and Grade B; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.
 1. Threaded Fittings:
 - a. Malleable-Iron Fittings: ASME B16.3, Class 300.
 - b. Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.
 - c. Fittings Working Pressure: 620 psig minimum.
 - d. Flanged Joints: Class 300 minimum.
 2. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
 3. Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.4 VALVES

- A. General Valve Requirements:
 - 1. UL listed or FM Approved for use in fire-protection systems.
 - 2. Compatible with type of clean agent used.
- B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.
- C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.
- D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.5 EXTINGUISHING-AGENT CONTAINERS

- A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
 - 1. Finish: Red, enamel or epoxy paint.
 - 2. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as required or indicated.
 - 3. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

2.6 FIRE-EXTINGUISHING CLEAN AGENT

- A. FK-5-1-12 Clean Agent: Dodecafluoro-2-methylpentan-3-one.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M.

2.7 DISCHARGE NOZZLES

- A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, size, discharge pattern, and capacity required for application.

2.8 CONTROL PANELS

- A. Description: FM Approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.
- B. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.
- C. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
 - 1. Mounting: Surface.
- D. Supervised Circuits: Separate circuits for each independent hazard area.
 - 1. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
 - 2. Manual pull-station circuit.
 - 3. Alarm circuit.
 - 4. Release circuit.
 - 5. Abort circuit.
 - 6. EPO circuit.
- E. Control-Panel Features:
 - 1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
 - 2. Automatic switchover to standby power at loss of primary power.
 - 3. Storage container, low-pressure indicator.
 - 4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.
- F. Standby Power: Sealed lead calcium batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.

2.9 REMOTE ANNUNCIATOR PANEL (RAP)

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Surface cabinet, NEMA 250, Type 1.

- B. Display Type and Functional Performance: 10 button alphanumeric remote display unit duplicating information provided by the fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals with key lock for additional security access.

2.10 DETECTION DEVICES

A. General Requirements for Detection Devices:

1. Comply with NFPA 2001, NFPA 72, and UL 268.
2. 24-V dc, nominal.

- B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

- C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.

- D. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.

2.11 MANUAL STATIONS

- A. General Description: Surface FM Approved or NRTL listed, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

- B. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.

- C. Abort Switch: "ABORT" caption, momentary contact, with green finish.

- D. EPO Switch: "EPO" caption, with yellow finish.

2.12 SWITCHES

- A. Description: FM Approved or NRTL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

1. Low-Agent Pressure Switches: Pneumatic operation.
2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
3. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.13 ALARM DEVICES

- A. Description: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting. Comply with requirements in Division 28 Section "Digital, Addressable Fire-Alarm

System" or Division 28 Section "Zoned (DC Loop) Fire-Alarm System" for alarm and monitoring devices.

- B. Bells: Minimum 6-inch diameter.
- C. Horns: 90 to 94 dBA.
- D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

2.14 ELECTRICAL POWER AND WIRING

- A. Electrical power, wiring, and devices are specified in Division 26.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FK-5-1-12 AGENT PIPING APPLICATIONS

- A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
- B. NPS 2 and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.
- C. NPS 2-1/2 and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints or steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

3.3 CLEAN-AGENT PIPING INSTALLATION

- A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.
- B. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.
- C. Install extinguishing-agent containers anchored to substrate.
- D. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution."
 - 1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.

2. Support piping using supports and methods according to NFPA 13.
3. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.
- C. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Division 28 Section "Digital, Addressable Fire-Alarm System" or Division 28 Section "Zoned (DC Loop) Fire-Alarm System."

3.5 IDENTIFICATION

- A. Identify system components and equipment. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.
- C. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.
- D. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Units will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.7 CLEANING

- A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

3.8 SYSTEM FILLING

A. Preparation:

1. Verify that piping system installation is completed and cleaned.
2. Check for complete enclosure integrity.
3. Check operation of ventilation and exhaust systems.

B. Filling Procedures:

1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.
2. Install filled extinguishing-agent containers.
3. Energize circuits.
4. Adjust operating controls.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain clean-agent fire-extinguishing systems.

END OF SECTION 21 2200

SECTION 23 0900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
 - 1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
- C. All FMS controls for Mechanical equipment shall be on generator power except for AHU-1 and AHU-2.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. MS/TP: Master slave/token passing.
- D. PC: Personal computer.
- E. PID: Proportional plus integral plus derivative.
- F. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F .
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F .
 - e. Ducted Air Temperature: Plus or minus 1 deg F .
 - f. Outside Air Temperature: Plus or minus 2 deg F .

- g. Dew Point Temperature: Plus or minus 3 deg F .
- h. Temperature Differential: Plus or minus 0.25 deg F .
- i. Relative Humidity: Plus or minus 3 percent.
- j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
- k. Airflow (Measuring Stations): Plus or minus 2 percent of full scale.
- l. Airflow (Terminal): Plus or minus 10 percent of full scale.
- m. Air Pressure (Space): Plus or minus 0.01-inch wg .
- n. Air Pressure (Ducts): Plus or minus 0.1-inch wg .
- o. Carbon Dioxide: Plus or minus 50 ppm
- p. Electrical: Plus or minus 5 percent of reading.

1.5 SEQUENCE OF OPERATION

- A. See plans for Sequence of Operation.

1.6 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Written description of sequence of operation.
 - 6. Schedule of dampers including size, leakage, and flow characteristics.
 - 7. Schedule of valves including flow characteristics.
 - 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 - 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.

10. Controlled Systems:
- a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.
 5. Software license required by and installed for DDC workstations and control systems.
- E. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Maintenance instructions and lists of spare parts for each type of control device.
 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 4. Calibration records and list of set points.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.
- D. In order to ensure the stability and availability of future service, the installer shall have at least 10 years of experience as a licensed contractor in the state in which the project is located.
- E. In order to ensure the availability of rapid response, the installer shall have a local facility or authorized service agent within a 25-mile radius of the job site. Emergency service shall be available on a 24-hour, 7-day-a-week basis.

- F. In order to ensure proper oversight, an employee with no less than 10 years of experience shall supervise the overall engineering, installation, programming and startup of the Facility Management System. This employee will be an engineer or project manager actively involved in the project.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system and refer to plans for additional requirements.
- C. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system and refer to plans for additional requirements.
- D. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- E. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces and refer to plans for additional requirements.
- F. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices and refer to plans for additional requirements.
- G. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices and refer to plans for additional requirements.
- H. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.10 WARRANTY

- A. Equipment: The control system components shall be free from defects in material and workmanship under normal use and service. If within one year from the date of completion any control system equipment is found to be defective, it will be replaced, repaired or adjusted at the option of the control system installer free of charge. The control system installer is not responsible for the removal or reinstallation of any components that were originally installed by others, such as valves, dampers, wells, airflow stations, etc...

- B. Installation: The control system shall be free from defects in installation workmanship for a period of one year from acceptance. This includes defective mounting, wiring, piping, adjustment, calibration, programming, startup and commissioning. The control system installer shall correct any defects in workmanship at no cost to the owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturer:

- 1. Invensys Building Systems; Johnson Controls Inc.

2.2 CONTROL SYSTEM

- A. The control system shall be an extension of the existing JCI control system located in the building. All new products provided under this section must be compatible with the existing system. The current Application Data Server must be able to view, monitor, control, program, and modify the new products provided under this section.
- B. This system shall be fully integrated with the lab control system at the JACE panel level. The lab control Jace panels and temperature control Jace panels shall reside on the same network and communicate via Bacnet. All control points attached the lab control system shall be accessed via the BMS.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- D. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- E. Control system shall include the following:
 - 1. Interface capabilities with Building lighting control system specified in Division 26 Section "Network Lighting Controls."
 - 2. Interface capabilities with Fire alarm system specified in Division 28 Section "Fire Detection and Alarm."
 - 3. Interface via Jace controllers to lab controls.

2.3 DDC SYSTEM GENERAL

- A. Network

1. The control system shall incorporate a primary Tier 1 network. At the Contractor's option, the control system may also incorporate integrated secondary Tier 2 and tertiary Tier 3 networks.
 2. The control system Network shall utilize an open architecture capable of all of the following:
 3. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec
 - a. Connecting via BACnet at the Tier 1 level in accordance with as per ANSI/ASHRAE Standard 135-2001.
 - b. Connecting via BACnet MSTP at the Tier 2 and Tier 3 level.
 4. The FMS network shall support both copper and optical fiber communication media.
- B. Power Fail / Auto Restart
1. Provide for the automatic orderly and predefined shutdown of parts or all of the control system following total loss of power to parts or all of the control system.
 2. Provide for the automatic orderly and predefined startup of parts or all of the control system following total loss of power to those parts or all of the control system. Archive and annunciate time and details of restoration.
 3. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.
 4. Maintain the control system real-time clock operation during periods of power outage for a minimum of 72 hours.
- C. Application Data Server (Existing JCI System)
- D. Operator Interface (Existing JCI system)

2.4 Network Automation Engines (NAE)

- A. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
- B. Automation network – The NAE shall reside on the Tier 1 automation network and shall support a subnet of system controllers.
- C. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI). All computers connected physically or virtually to the automation network shall have access to the web based UI.
 1. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
 2. The web based user shall have the capability to access all system data through one NAE.
 3. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
 4. Systems that require the user to address more than one NAE to access all system information are not acceptable.
 5. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.

6. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
 7. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
 - a. Configuration
 - b. Commissioning
 - c. Data Archiving
 - d. Monitoring
 - e. Commanding
 - f. System Diagnostics
 8. Systems that require workstation software or modified web browsers are not acceptable.
 9. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
- D. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.
- E. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
- F. Hardware Real Time Clock – The NAE shall include an integrated, hardware-Based, real-time clock.
- G. The NAE shall include troubleshooting LED indicators to identify operating conditions.
- H. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.
1. USB port
 2. URS-232 serial data communication port
 3. RS-485 port
 4. Ethernet port
- I. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
- J. Power Failure – In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
1. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
 2. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
- K. Certification – The NAE shall be listed by Underwriters Laboratories (UL).

L. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

1. The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
2. The NAE shall be tested and certified as a BACnet Building Controller (B-BC).

2.5 DDC System Controllers

A. Field Equipment Controller (FEC)

1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - a. The FEC shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - b. The FEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - c. The FEC shall be tested and certified as a BACnet Application Specific Controller (B-SC).
2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences.
3. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
4. The FEC shall include a removable base to allow pre-wiring without the controller.
5. The FEC shall include troubleshooting LED indicators to identify operating conditions.
6. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
7. The FEC shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - 5) Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - 1) 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode

8. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
 - a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The FC Bus shall support communications between the FECs and the NAE.
 - c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.
 - d. The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.
 - e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

9. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices per trunk.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.

10. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
11. The FEC shall support, but not be limited to, the following:
 - a. Hot water, chilled water/central plant applications
 - b. Built-up air handling units for special applications
 - c. Terminal units
 - d. Special programs as required for systems control

12. Application Specific Controllers for Central Plant and air handling unit applications shall have a Local Controller Display as an integral part of the ASC. Application Specific Controllers serving central plant and air handling unit applications that do not support a Local Controller Display will have hand-off-auto switches for digital outputs, potentiometer overrides for analog outputs, status lights for binary inputs, and digital gauges for analog inputs.
 - a. The Display shall use a BACnet Standard SSPC-135, clause 9 Master-Slave/Token-Passing protocol.
 - b. The Display shall allow the user to view monitored points without logging into the system.
 - c. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.
 - d. The Display shall be menu driven.
 - e. The Display shall use easy-to-read English text messages.
 - f. The Display shall allow the user to select the points to be shown and in what order.
 - g. The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightness and automatic backlight brightening during user interaction.
 - h. The display shall be a minimum of 4 lines and a minimum of 20 characters per line.

B. Input/Output Module (IOM)

1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
2. The IOM shall communicate with the FEC over the FC Bus or the SA Bus.

3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - a. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
4. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
5. The IOM shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - 5) Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - 1) 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
6. The IOM shall include troubleshooting LED indicators to identify operating conditions.

C. Terminal Equipment Controller (TEC)

1. The TEC shall be capable of controlling two- or four-pipe fan coils, cabinet unit heaters or other similar equipment.
2. The TEC shall communicate over the Field Controller Bus using BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.
 - a. The TEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The TEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
3. The TEC shall support remote read/write and parameter adjustment from the web based User Interface through a Network Automation Engine.
4. The TEC shall include an intuitive User Interface providing plain text messages.
5. The TEC shall provide the flexibility to support any one of the following inputs:

- a. Integral Indoor Air Temperature Sensor
 - b. Duct Mount Air Temperature Sensor
 - c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator
 - d. Two configurable binary inputs
6. The TEC shall provide the flexibility to support any one of the following outputs:
- a. Three Speed Fan Control
 - b. Two On/Off
 - c. Two Floating
 - d. Two Proportional (0 to 10V)
7. The TEC shall provide the flexibility to adjust the following parameters:
- a. Adjustable Temporary Occupancy from 0 to 24 hours
 - b. Adjustable heating/cooling deadband from 2° F to 5° F
 - c. Adjustable heating/cooling cycles per hour from 4 to 8
8. The TEC shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.
- D. VAV Modular Assembly (VMA)
- 1. The VMA shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.
 - 2. The VMA shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.
 - a. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The VMA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - 3. The VMA shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
 - 4. The VMA shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.
 - 5. The VMA shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 - 6. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
 - 7. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.
 - 8. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
 - 9. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
 - 10. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

11. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
12. Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
13. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
14. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
15. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
16. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance.
17. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:
 - a. Unreliable space temperature sensor
 - b. Unreliable differential pressure sensor
 - c. Starved box
 - d. Actuator stall
 - e. Insufficient cooling
 - f. Insufficient heating
18. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.
19. Inputs:
 - a. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
 - 1) 0-10 VDC Sensors
 - 2) 1000ohm RTDs
 - b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
 - c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
 - d. Provide side loop application for humidity control.
20. Outputs
 - a. Analog outputs shall provide the following control outputs:
 - 1) 0-10 VDC
 - b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
 - c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

21. Application Configuration
22. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.
23. Sensor Support
 - a. The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
 - b. The VMA shall support an LCD display room sensor.
 - c. The VMA shall also support standard room sensors as defined by analog input requirements.
 - d. The VMA shall support humidity sensors defined by the AI side loop.

E. Network Sensors (NS)

1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
 - a. Zone Temperature
 - b. Zone Humidity
 - c. Zone Setpoint
 - d. Discharge Air Temperature
2. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
 - a. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
3. The Network Zone Sensors shall include the following items:
 - a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature and Setpoint
 - b. An LED to indicate the status of the Override feature
 - c. A button to initiate a timed override command
4. The Network Discharge Air Sensors shall include the following:
 - a. 4 inch or 8 inch duct insertion probe
 - b. 10 foot pigtail lead
 - c. Dip Switches for programmable address selection

2.6 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. RTDs and Transmitters:
 1. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 2. Averaging Elements in Ducts: 17 feet long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 3. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches. Provide stainless steel socket on medium temperature heating water system.
 4. Room Sensor Cover Construction: Manufacturer's standard locking covers.

- a. Exposed setpoint adjustment.
 - b. Override button..
 - c. LCD Display.
 - d. Color: White.
5. Room sensor accessories include the following:
- a. Insulating Bases: For sensors located on exterior walls.
 - b. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base. Locate where shown on the plans.
 - c. Adjusting Key: As required for calibration and cover screws.
6. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
7. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. Humidity Sensors:

- 1. Accuracy: 2 percent full range with linear output.
- 2. Room Sensor Range: 20 to 80 percent relative humidity.
- 3. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
- 4. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg .

D. Pressure Transmitters/Transducers:

- 1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 1 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA. or 0 to 10 VDC
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg.
- 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA or 0 to 10 VDC.
- 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA or 0 to 10 VDC.
- 4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

2.7 STATUS SENSORS

- A. Status Inputs for Fans, Pumps, and Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- B. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

- C. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- E. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.8 WATER FLOW MONITORING

- A. Provide water flow meters where shown on the plans.
- B. Provide Badger M-2000 mag meter.
- C. Liquid temperature range shall be:
 - 1. -4F to 212F.
- D. Ambient temperature range of -4F to 140F.
- E. LCD indicator with remote totalizer.

2.9 THERMOSTATS

- A. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.
 - 1. Label switches "FAN ON-OFF" .
 - 2. Mount on single electric switch box.
- B. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual on-off-auto.
- C. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- D. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
 - 1. Bulb Length: Minimum 20 feet.
 - 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

2.10 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
 3. Coupling: V-bolt and V-shaped, toothed cradle.
 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 6. Power Requirements (Two-Position Spring Return): 24 or 120 V ac.
 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 8. Proportional Signal: 0- to 10-V dc or 4 to 20 mA.

2.11 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with back seating capacity repackable under pressure.
 2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.

- a. Sizing: 5-psig maximum pressure drop at design flow rate.
 - 4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 - 5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 100 percent of total system (pump) head.
- C. Butterfly Valves: ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
- 1. Body Style: Lug
 - 2. Disc Type: Aluminum bronze.
 - 3. Sizing: 1-psig maximum pressure drop at design flow rate.
- D. Ball pattern valves shall have the following characteristics:
- 1. Up to 2 inches: Forged brass body, chrome plated brass ball, nickel plated brass stem, graphite reinforced PTFE seats with EPDM O-ring backing, screwed ends or solder ends with union.
 - 2. Over 2 inches: Brass body, stainless steel ball, stainless steel stem, graphite reinforced PTFE seats with EPDM O-ring backing, flanged ends.
 - 3. Rate for service pressure of 125 psig at 250 degrees F.
 - 4. Sizing: 5-psig maximum pressure drop at design flow rate.
 - 5. Flow Characteristics: Two way valves shall have equal percentage characteristics.
 - 6. Close-Off (Differential) Pressure Rating: Valve actuator shall provide minimum close-off pressure rating of 100 percent of total system (pump) head.

2.12 DAMPERS

- A. Dampers: AMCA-rated, opposed-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 - 1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 - 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.

3.2 INSTALLATION

- A. Install software in control units. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- F. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. The entire control system shall be installed in a workmanlike manner in accordance with the manufacturer's wiring diagrams. The control system installer shall provide all wiring, conduit, outlet boxes, junction boxes, panels and similar devices necessary for a complete installation.
- B. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- C. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Wiring in mechanical/electrical rooms and concealed spaces shall be in conduit.
 - 3. Exposed wiring shall only be allowed in concealed accessible locations. Wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
 - 8. All wiring shall be installed in accordance with local code requirements.

- E. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- F. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 5. Test each system for compliance with sequence of operation.
 - 6. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.
 - 5. Check installation of air supply for each instrument.
 - 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 8. Check temperature instruments and material and length of sensing elements.
 - 9. Check control valves. Verify that they are in correct direction.
 - 10. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

- A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
3. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span.
4. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
5. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
6. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate temperature switches to make or break contacts.
7. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
8. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
9. Provide diagnostic and test instruments for calibration and adjustment of system.
10. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 TRAINING

A. The control system installer shall provide the following training services:

1. One day on-site orientation consisting of a review of the project as-built drawings and O&M manuals, and a walk through of the facility to identify control panels and device locations. Include instruction on procedures for recovery from a system outage such as resetting of breakers or panels. Also include review of periodic maintenance and adjustment requirements.
2. One day on-site or classroom training to cover all sequences of operation.

3. One day on-site or classroom training to cover user functions of the operator interface. Include such topics as logging-on and off, alarm management, schedule management, data and setpoint display, command, override and adjustment, report generation, and trend log set-up and analysis.
4. One day on-site or classroom training to cover management functions of the operator interface. Include such topics as password management, operator activity review, and system archive and database management.

END OF SECTION 23 0900

SECTION 23 3300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Combination fire and smoke dampers.
7. Flange connectors.
8. Duct silencers.
9. Turning vanes.
10. Remote damper operators.
11. Duct-mounted access doors.
12. Flexible connectors.
13. Flexible ducts.
14. Duct accessory hardware.

- B. Related Sections:

1. Division 28 Section "Addressable Fire Alarm Systems" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

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

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

- a. Special fittings.

- b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arrow United Industries; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
 - 5. SEMCO Incorporated.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Felt.
- I. Blade Axles:
 - 1. Material: Nonferrous metal.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Screen Mounting: Rear mounted.
 - 4. Screen Material: Galvanized steel.
 - 5. Screen Type: Insect.
 - 6. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow United Industries; a division of Mestek, Inc.
 - b. Greenheck Fan Corp.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
 - f. Pottorff
 2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Galvanized steel.
- B. Jackshaft:
1. Size: 1-inch diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.4 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arrow United Industries; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. Metal Form Manufacturing, Inc.
5. Nailor Industries Inc.
6. Ruskin Company.
7. Pottorff

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches .
2. Parallel- and opposed-blade design.
3. Galvanized steel.
4. 0.064 inch thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Oil-impregnated bronze, Molded synthetic or Stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.5 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following::

1. Arrow United Industries; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. Nailor Industries Inc.

- 5. Ruskin Company.
 - 6. Pottorff
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
 - C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity. Fire dampers located in medium pressure ductwork shall have minimum 3000-fpm velocity rating.
 - D. Fire Rating: 1-1/2 and 3 hours.
 - E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
 - F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
 - G. Mounting Orientation: Vertical or horizontal as indicated.
 - H. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
 - I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
 - J. Heat-Responsive Device: Replaceable, 165 deg F rated fusible links.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
- B. If both types of dampers are required in first paragraph below, indicate location of each on Drawings.
- C. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- D. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm. Fire dampers located in medium pressure ductwork shall have minimum 3000-fpm velocity rating.
- E. Fire Rating: 1-1/2 and 3 hours.

- F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- G. Smoke Detector: Integral, factory wired for single-point connection.
- H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Leakage: Class I.
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- L. Master control panel for use in dynamic smoke-management systems.
- M. Damper Motors: Modulating or two-position action.
- N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf .
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F .
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. , size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf .
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- O. Accessories:
 - 1. Test and reset switches, damper mounted.

2.7 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. METALAIRE, Inc.
 - 3. SEMCO Incorporated.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.9 REMOTE POWERED DAMPER OPERATORS

- A. Basis of Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Pottorff; a division of PCI Industries, Inc.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company.
 - 4. United Enertech.
- B. Description: Remote powered regulator system designed for remote manual damper adjustment.
- C. Wall-Box Mounting: Recessed, 2 inches deep or Surface.
- D. Wall-Box Cover-Plate Material: Steel.

2.10 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Ductmate Industries, Inc.
 3. Flexmaster U.S.A., Inc.
 4. Greenheck Fan Corporation.
 5. Nailor Industries Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.11 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F .
- F. Minimum Pressure Rating: 10-inch wg , positive or negative.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd. .
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- E. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.13 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.

- C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
- D. Flexible Duct Connectors:
 - 1. Clamps: Nylon strap in sizes 3 through 18 inches , to suit duct size.

2.14 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers according to UL listing.
- G. Connect ducts to duct silencers rigidly.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.

4. At drain pans and seals.
 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 7. At each change in direction and at maximum 50-foot spacing.
 8. Upstream or downstream from duct silencers.
 9. Control devices requiring inspection.
 10. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
 2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

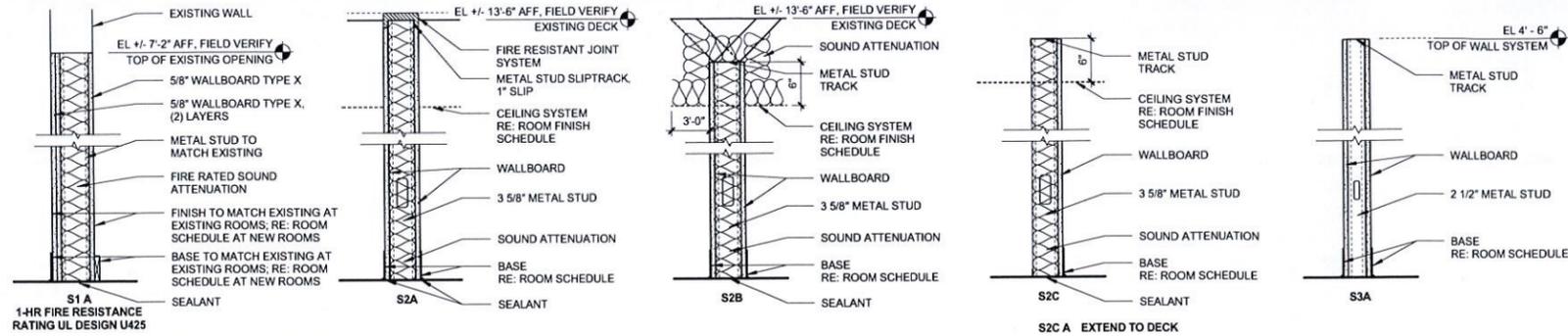
3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.

4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 3300

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D1 PARTITION TYPES
1" = 1'-0"

DOOR NO.	ROOM NAME	TYPE	DOOR				FRAME		FIRE RATING MINUTES	HDW SET NO.	DETAIL			NOTES
			WIDTH	HEIGHT	MATERIAL	FINISH	GLAZING	TYPE			FINISH	HEAD	JAMB	
201A	CORRIDOR	N	(1) 3'-0", (1) 1'-6"	7'-0"	WD	ST-1/ ST-2	G2	F1	PT-1	45	3	D1-A501	C1-A501	1, 3, 4
202A	WORK ROOM	N	(1) 3'-0"	7'-0"	HM	PT-1	G1	F1	PT-1	45	5	D1-A501	C1-A501	1, 4
203A	CORRIDOR	N	(1) 3'-0"	7'-0"	HM	PT-1	G2	F1	PT-1	45	5	D1-A501	C1-A501	1, 4
205A	LAB	SL	(1) 4'-0"	7'-0"	AL		G1	AA		12		D2-A501	C2-A501	
205B	LAB	SL	(1) 4'-0"	7'-0"	AL		G1	AA		12		D2-A501	C2-A501	
206A	OFFICE	FG	(1) 3'-0"	7'-0"	AL		G1	CC		11		D4-A501 SIM	C4-A501	
207A	LAB	SL	(1) 4'-0"	7'-0"	AL		G1	BB		12		D3-A501	C2-A501	
208A	DIGITIZATION ROOM	SL	(1) 5'-0"	7'-0"	AL		G3	BB		12		D3-A501	C2-A501 SIM	
209A	LAB	SL	(1) 4'-0"	7'-0"	AL		G1	BB		12		D3-A501	C2-A501	
210A	CORRIDOR	N	(1) 3'-0", (1) 1'-6"	7'-0"	HM	PT-1	G1	F1	PT-1	45	7	D1-A501	C1-A501	1, 3
210B	CORRIDOR	F	(1) 3'-0", (1) 1'-6"	7'-0"	HM	PT-1	-	F1	PT-1	45	4	D1-A501	C1-A501	1, 4
211A	COLLECTIONS STORAGE	F	(1) 3'-0", (1) 1'-6"	7'-0"	HM	PT-1	-	F1	PT-1	45	8	D1-A501	C1-A501	B1-A501, 1, 2
211B	COLLECTIONS STORAGE	F	(1) 3'-0"	7'-0"	HM	PT-1	-	F1	PT-1	45	6	D1-A501	C1-A501	B1-A501, 1, 2, 4
212A	NAGPRA STORAGE	F	(1) 3'-0"	7'-0"	HM	PT-1	-	F1	PT-1	45	9	D1-A501	C1-A501	B1-A501, 1, 2
213A	OVERSIZED OBJECT STORAGE	F	(2) 3'-0"	7'-0"	HM	PT-1	-	F1	PT-1	45	2	D1-A501	C1-A501	1, 2, 4
214A	FIRE SUPPRESSION	F	(2) 3'-0"	7'-0"	HM	PT-1	-	F1	PT-1	45	1	D1-A501	C1-A501	4

DOOR SCHEDULE NOTES:

- CARD READER MOUNTED TO FRAME. RE: MANUFACTURER SPECIFICATION
- SMOKE SEALS AT FRAME AND THRESHOLD
- SMALLER LEAVES OF ALL UNEVEN DOUBLE DOORS TO BE TYPE F FLUSH DOORS
- SIDES OF DOORS FACING EXISTING ROOMS TO MATCH EXISTING STAIN / PAINT FINISH

MARK	ROOM NAME	FLOOR	BASE	WALLS				CEILING		NOTES
				NORTH	EAST	SOUTH	WEST	HEIGHT	FINISH	
201	CORRIDOR	SC	RB	N/A	PT-1	PT-1	PT-1	9'-0"	ACT	
202	WORK ROOM	SC	RB	PT-1	PT-1	PT-1	PT-1	9'-0"	ACT	
203	CORRIDOR	SC	RB	PT-1	PT-1	PT-1	PT-1	9'-0"	ACT	
204	OPEN OFFICE	SC	RB	PT-1	PT-1	PT-1	PT-1	9'-0"	ACT	
205	LAB	SC	RB	PT-1	PT-1/P2	PT-1/P2	PT-1	9'-0"	ACT	RE: C1/A401
206	OFFICE	SC	RB	PT-1	PT-1	PT-1	PT-1	9'-0"	ACT	
207	LAB	SC	RB	PT-1	PT-1/P3	PT-1/P3	PT-1	9'-0"	ACT	RE: C1/A401
208	DIGITIZATION ROOM	SC	RB	PT-5	PT-5	PT-5	PT-5	9'-0"	ACT	
209	LAB	SC	RB	PT-1	PT-1/P4	PT-1/P4	PT-1	9'-0"	ACT	RE: C1/A401
210	CORRIDOR	SC	RB	PT-1	PT-1	PT-1	PT-1	N/A	PT-1	
211	COLLECTIONS STORAGE	CONC	RB	PT-1	PT-1	PT-1	PT-1	N/A	PT-1	
212	NAGPRA STORAGE	CONC	RB	PT-1	PT-1	PT-1	PT-1	N/A	PT-1	
213	OVERSIZED OBJECT STORAGE	SC	RB	PT-1	PT-1	PT-1	PT-1	N/A	PT-1	
214	FIRE SUPPRESSION	SC	RB	PT-1	PT-1	PT-1	PT-1	N/A	PT-1	

PAINT

PT-1 MANF COLOR	SHERWIN WILLIAMS SW 7014, EIDER WHITE
PT-2 MANF COLOR	SHERWIN WILLIAMS SW 6227, MEDITATIVE
PT-3 MANF COLOR	SHERWIN WILLIAMS SW 7599, BRICK PAVER
PT-4 MANF COLOR	SHERWIN WILLIAMS SW 9029, COOL AVOCADO
PT-5 MANF COLOR	SHERWIN WILLIAMS SW 7673, PEWTER CAST

FLOORING

CONC COLOR	CONCRETE TOPPING GRAY
SC	SEALED CONCRETE

BASE

RB-1 MANF COLOR	ROPPE 100 BLACK
-----------------------	--------------------

TACKABLE SURFACE

TS MANF COLOR	WALLTALKERS C250-01 AUTUMN
---------------------	-------------------------------

GLAZING

G1	1/4" TEMPERED GLAZING
G2	1/4" RATED GLAZING
G3	1/4" COMPOSITE INFILL PANEL

PLASTIC LAMINATE

PLAM MANF COLOR	FORMICA 934-58 PEARL
-----------------------	-------------------------

CEILING

ACT	ARMSTRONG, OPTIMA 2' x 2' SQUARE LAY-IN
O.T.S.	OPEN TO STRUCTURE

PVC EDGE BANDING

EB-1 MANF ARTICLE NO. PRODUCT LINE COLOR	REHAU 302114-513 FLEXEDGE (3MM) C100141
EB-2 MANF ARTICLE NO. PRODUCT LINE COLOR	REHAU 303734-504 THIN EDGEBAND (5/8" X 0.18") C600001

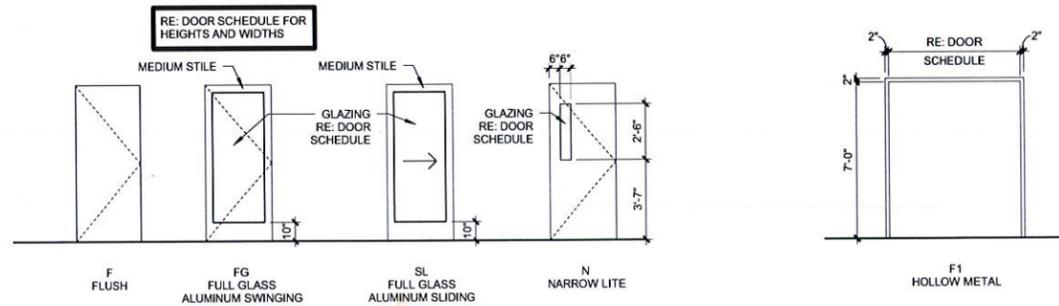
WOOD

WV-1	WOOD VENEER, LIGHT MAPLE WITH CLEAR FINISH
ST-1	STAIN, LIGHT MAPLE
ST-2	STAIN TO MATCH EXISTING WOOD FINISH SOUTH OF DOOR 201A

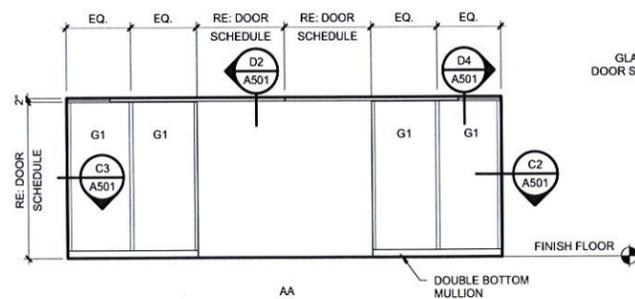
A4 ROOM FINISH SCHEDULE
N.T.S.

REVISION	BY	DATE	PLAN SCALE	DRAWN	KM	08.25.16	APPROVED:
1		11.17.16	RE: DRAWINGS	DESIGNED	WMBP		 CITY ENGINEER DATE: 11/20/16 SHEET 8 OF 29 SHEETS SHEET NO: A001
			PROFILE SCALE	PROJ MGR.			
			HORIZONTAL:	LEAD ENG.			
			VERTICAL:	RECOMMENDED:			
			FILE:	DESIGN MANAGER			
			ATLAS PAGE NO:	DRAWING			
			SHEET NAME:	SCHEDULES AND FRAME TYPES			

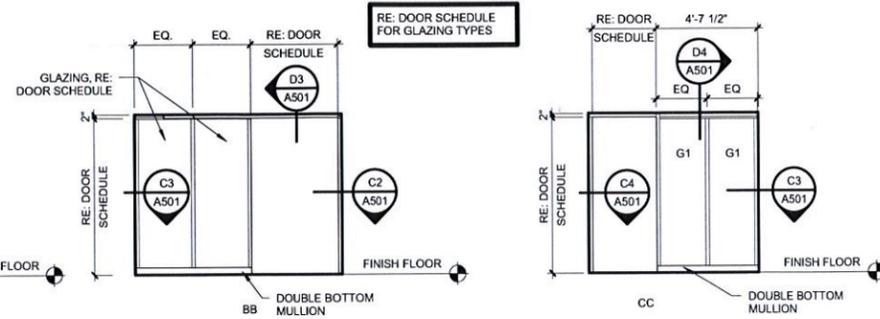
C1 DOOR SCHEDULE
N.T.S.



B1 DOOR TYPES
1/4" = 1'-0"



B2 FRAME TYPES
1/4" = 1'-0"



A1 STOREFRONT ELEVATIONS
1/4" = 1'-0"

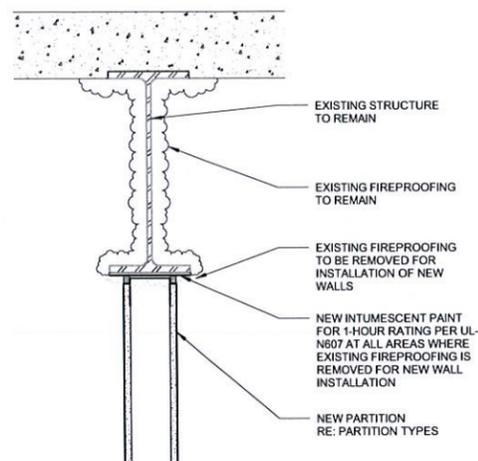


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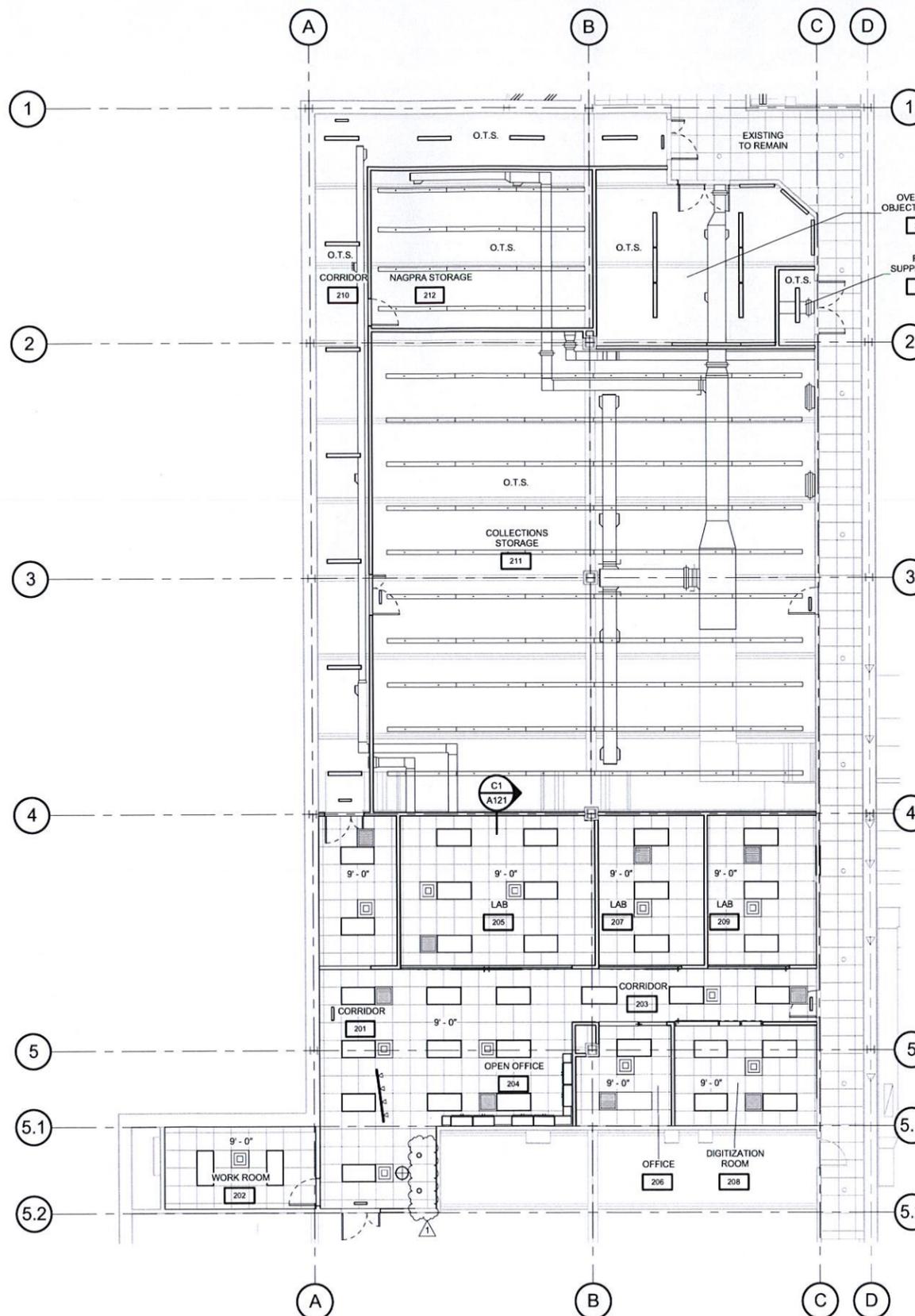
PROJECT NO.: 145620

CITY OF TULSA, OKLAHOMA
ENGINEERING SERVICES
DEPARTMENT

PLANS AND ESTIMATES PREPARED BY:
SELSE SCHAEFER ARCHITECTS
2002 EAST 6TH STREET
TULSA, OKLAHOMA 74104
918.587.2282 | F 918.587.2285
WWW.SELSERSCHAEFER.COM



C1 DETAIL
 1 1/2" = 1'-0"



A2 REFLECTED CEILING PLAN
 1/8" = 1'-0"

- ELECTRICAL**
- DIRECT INDIRECT RECESSED LIGHT FIXTURE
 - DIRECT INDIRECT SUSPENDED LINEAR LIGHT FIXTURE
 - SUSPENDED PENDANT LIGHT FIXTURE
 - TRACK LIGHT FIXTURE
 - RECESSED CAN LIGHT
 - EXIT SIGN
- MECHANICAL**
- SUPPLY AIR DIFFUSER
 - RETURN AIR GRILLE
- CEILING**
- 2X2 SUSPENDED ACOUSTICAL CEILING
 - OPEN TO STRUCTURE PAINTED AS INDICATED ON ROOM FINISH SCHEDULE

C5 RCP LEGEND
 N.T.S.



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REVISION	BY	DATE	PLAN SCALE:	DRAWN:	KM	08.25.16	APPROVED:
ADDENDUM 1		11.17.16	RE DRAWINGS	DESIGNED	WM/BP		
				SURVEY			
			PROFILE SCALE	PROJ MGR.			
			N/A	LEAD ENG.			
			HORIZONTAL:	FIELD MGR.			
			N/A	RECOMMENDED:			
			VERTICAL:	DESIGN MANAGER			
			N/A				
			FILE:	CITY ENGINEER			
			DRAWING:	DATE			
			ATLAS PAGE NO:	SHEET	11	29	SHEETS
			SHEET NAME:	REFLECTED CEILING PLAN			SHEET NO: A121





ELECTRIC DUCT HEATER SCHEDULE

UNIT DESIGNATION	EDH-4-1	EDH-5-1	EDH-5-2	EDH-5-3	
MANUFACTURER	INDEECO	INDEECO	INDEECO	INDEECO	
MODEL NO.	TFXU	TFXU	TFXU	TFXU	
FACE LENGTH - INCHES	12	26	14	24	
FACE HEIGHT - INCHES	10	12	8	20	
MOUNTING - SLIP IN OR FLANGED	SLIP IN	SLIP IN	SLIP IN	SLIP IN	
AIR SIDE	FLOW RATE - CFM (L/s)	450	1750	520	3720
	FACE VELOCITY - FPM (m/s)	540	808	669	1116
	STATIC PRESSURE DROP - IN. WG (Pa)	0.50	0.5	0.5	0.50
	TOTAL CAPACITY - MBH (kW)	20.5	54.6	17.1	119.4
	ENTERING TEMPERATURE - DEG F	52	52	52	52
	LEAVING TEMPERATURE - DEG F	93.9	80.8	82.2	80.8
ELECTRICAL	CAPACITY - KW	6	16	5	35
	NO. OF STEPS	-	-	-	-
	VOLTS	480	480	480	480
	PHASE	3	3	3	3
	HERTZ	60	60	60	60
REMARKS	1.2	1.2	1.2	1.2	
REMARKS	1. PROVIDE SCR CONTROLLER.  2. NEPTRONIC IS AN APPROVED MANUFACTURER. 				

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FIXTURE SCHEDULE

TYPE	MANUFACTURER & CATALOG NUMBER	LAMP QUANTITY/TYPE MANUFACTURER	DESCRIPTION
A	CORELITE Z3-W-G-1-L35-1-C- UNV-24-AR OR EQUAL BY: LIGHTOLIER OR LITHONIA	INTEGRAL LED FURNISHED WITH LIGHT FIXTURE WITH 3500K COLOR TEMPERATURE	2' X 4' RECESSED DIRECT LED FIXTURE WITH WHITE FINISH AND INTERNAL LED DRIVER/BALLAST. PROVIDE FIXTURE WITH AIR RETURN CAPABILITIES. PROVIDE DOCUMENTATION FROM FIXTURE MANUFACTURER FOR THE FIELD REPLACEABLE LED LAMPS OR LED LAMP MODULES FOR FUTURE LED LAMP REPLACEMENT. PROVIDE FIVE (5) YEAR MINIMUM COMPLETE MATERIALS AND LABOR REPLACEMENT WARRANTY FOR LIGHT FIXTURE.
B	CORELITE - COOPER RZL-W-L-1-L35-1-D- UNV A-C-48-XX-STD-W AXIS LIGHTING TBDILED-B1-850/520- 35-SO-XX-M11LED-W- UNV-D-1-CT-D OR EQUAL BY:	INTEGRAL LED FURNISHED WITH LIGHT FIXTURE WITH 3500K COLOR TEMPERATURE	4' LINEAR DIRECT/INDIRECT LED PENDANT WITH DIMMING. PROVIDE WITH WHITE FINISH. COORDINATE EXACT FIXTURE LENGTHS AND AIRCRAFT CABLE SUSPENSION HEIGHTS WITH ARCHITECT/ENGINEER PRIOR TO ORDERING AND INSTALLATION. COORDINATE AIRCRAFT CABLE SUSPENSIONS WITH MECHANICAL DUCTWORK, SUSPENSIONS MAY BE STAGGERED AS REQUIRED TO AVOID DUCTWORK. PROVIDE SHOP DRAWINGS WITH SUSPENSION LOCATIONS. PROVIDE DOCUMENTATION FROM FIXTURE MANUFACTURER FOR THE FIELD REPLACEABLE LED LAMPS OR LED LAMP MODULES FOR FUTURE LED LAMP REPLACEMENT AT 70% LUMEN MAINTENANCE PER IESNA LM-79. INFORMATION SHALL INCLUDE LED POWER SUPPLY/DRIVER AND LED/MODULE MODEL NUMBERS. PROVIDE FIVE (5) YEAR MINIMUM COMPLETE MATERIALS AND LABOR REPLACEMENT WARRANTY FOR LIGHT FIXTURE.
C	COOPER LIGHTING METALUX 4WPLD4035C OR EQUAL BY LIGHTOLIER, DAY- BRITE OR LITHONIA	INTEGRAL LED FURNISHED WITH LIGHT FIXTURE WITH 3500K COLOR TEMPERATURE	4'-0" SURFACE-MOUNTED LINEAR LED STRIP LIGHT FIXTURE. FURNISH FIXTURE WITH OPAL ACRYLIC DIFFUSER. FURNISH WITH INTEGRAL LED LAMPING WITH FIELD REPLACEABLE LED LAMPS OR LED LAMP MODULES WITH 5200 TOTAL LUMENS OUTPUT. VERIFY FIXTURE FINISH WITH ARCHITECT. FURNISH WITH 120V OPERATION. PROVIDE DOCUMENTATION FROM FIXTURE MANUFACTURER FOR THE FIELD REPLACEABLE LED LAMPS OR LED LAMP MODULES FOR FUTURE LED LAMP REPLACEMENT AT 70% LUMEN MAINTENANCE PER IESNA LM-79. INFORMATION SHALL INCLUDE LED POWER SUPPLY/DRIVER AND LED/MODULE MODEL NUMBERS. PROVIDE FIVE (5) YEAR MINIMUM COMPLETE MATERIALS AND LABOR REPLACEMENT WARRANTY FOR LIGHT FIXTURE.
D	LITHONIA LRP LED 1/2 RMR 120/277 MCPHILBEN 44RLU-1-R DUAL-LITE LESCSR(X)NA(SURFACE EDGE)TEXT/AC/X/RED- CLR/SATIN)(XFACE) EVENLITE SOV-AC-R-1M/2M-BA- XX-XX OR EQUAL BY: LIGHTOLIER OR DAY- BRITE	FURNISHED WITH FIXTURE	EDGE LIT ACRYLIC LED EXIT SIGN LIGHT. DOUBLE FACE EXITS SHALL HAVE RED LETTERS ON MIRRORED BACKGROUND, SINGLE FACE EXITS SHALL HAVE RED LETTERS ON MIRRORED BACKGROUND. PROVIDE WALL OR CEILING MOUNT AS REQUIRED. PROVIDE SINGLE OR DOUBLE FACE AND DIRECTIONAL ARROWS AS SHOWN. VERIFY MOUNTING.

FIXTURE SCHEDULE

TYPE	MANUFACTURER & CATALOG NUMBER	LAMP QUANTITY/TYPE MANUFACTURER	DESCRIPTION
E	OWNER FURNISHED CONTRACTOR INSTALLED		OWNER FURNISHED CONTRACTOR INSTALLED 2X4 LIGHT FIXTURE.
F	CORELITE Z3-W-G-2-L35-1-D- UNV-24-AR OR EQUAL BY: LIGHTOLIER OR LITHONIA	INTEGRAL LED FURNISHED WITH LIGHT FIXTURE WITH 3500K COLOR TEMPERATURE	2' X 4' RECESSED DIRECT LED FIXTURE WITH WHITE FINISH AND INTERNAL LED DRIVER/BALLAST. PROVIDE FIXTURE WITH AIR RETURN CAPABILITIES. PROVIDE DOCUMENTATION FROM FIXTURE MANUFACTURER FOR THE FIELD REPLACEABLE LED AMPS OR LED LAMP MODULES FOR FUTURE LED LAMP REPLACEMENT. PROVIDE FIVE (5) YEAR MINIMUM COMPLETE MATERIALS AND LABOR REPLACEMENT WARRANTY FOR LIGHT FIXTURE.
G	ALKCO SFHP-213 OR EQUAL BY LIGHTOLIER, METALUX OR DAY-BRITE	2-F13T5/30U PHILIPS	42" IN LENGTH "LITTLE INCH" SOLID FRONT UNDER CABINET FIXTURE. FURNISH WITH 120 VOLT OPERATION.
H	YLIGHTING 2752. KOMA MEIJI	INTEGRAL LED FURNISHED WITH LIGHT FIXTURE WITH 3000K COLOR TEMPERATURE	15" DIAMETER DECORATIVE LED PENDANT. FURNISH WITH BLACK ALUMINUM EXTERIOR FINISH WITH BLACK SILK COVERED CORD, SATIN WHITE INTERIOR FINISH. FURNISH WITH 277V OPERATION. PROVIDE DOCUMENTATION FROM FIXTURE MANUFACTURER FOR THE FIELD REPLACEABLE LED LAMPS OR LED LAMP MODULES FOR FUTURE LED LAMP REPLACEMENT. PROVIDE FIVE (5) YEAR MINIMUM COMPLETE MATERIALS AND LABOR REPLACEMENT WARRANTY FOR LIGHT FIXTURE.
I	BRUCK LIGHTING MAG 2 SPOT (TRACK) MAG 2 SPOT (TRACK FIXTURE) WITH ALL COMPONENTS ACCESSORIES LISTED ABOVE AND IN THE DESCRIPTION EXCLUDING INTEGRAL DIMMER	INTEGRAL LED FURNISHED WITH LIGHT FIXTURE WITH 3500K COLOR TEMPERATURE	6'-0" SURFACE MOUNTED 1-CIRCUIT TRACK WITH ADJUSTABLE LED FIXTURES. PROVIDE EACH FIXTURE ASSEMBLY WITH LENGTHS TO MATCH LENGTHS SHOWN IN DRAWINGS. FIELD CUT TRACK AS REQUIRED TO ACCOMMODATE LENGTHS INDICATED. COORDINATE FIXTURE AIMING AND EXACT LAMP DISTRIBUTION TYPE FOR EACH LUMINAIRE WITH ENGINEER/ARCHITECT PRIOR TO INSTALLATION. PROVIDE ALL FEEDS, CONNECTORS AND MOUNTING HARDWARE TO ALLOW FOR A COMPLETE INSTALLATION. FINISH OF TRACK, FIXTURES, CANOPY, STEM AND ALL OTHER VISIBLE COMPONENTS SHALL BE WHITE. FIXTURE SHALL BE SURFACE MOUNTED TO CEILING SYSTEM, COORDINATE EXACT MOUNTING WITH THE ARCHITECT. FURNISH WITH 277V OPERATION. AS PART OF SUBMITTALS: PROVIDE 1/2" = 1'-0" SCALE SHOP DRAWINGS FOR TYPICAL TRACK LIGHTING INSTALLATIONS. SHOP DRAWINGS SHALL INCLUDE LOCATIONS OF FIXTURES, MOUNTING SUPPORTS AND POWER FEEDS, INCLUDING DETAILS OF ALL SUPPORTS/POWER FEEDS AND ALL OTHER FIXTURE COMPONENTS.
J	LIGHTOLIER CALCULITE LED 6" SERIES OR EQUAL BY: GOTHAM OR HALO	LED FURNISHED WITH FIXTURE	6" RECESSED LED DOWNLIGHT WITH WHITE FINISH AND INTEGRAL DRIVER. PROVIDE DOCUMENTATION FROM FIXTURE MANUFACTURER FOR THE FIELD REPLACEABLE LED LAMPS OR LED LAMP MODULES FOR FUTURE LED LAMP REPLACEMENT. PROVIDE FIVE (5) YEAR MINIMUM COMPLETE MATERIALS AND LABOR REPLACEMENT WARRANTY FOR LIGHT FIXTURE.



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DEPARTMENT

PLANS AND ESTIMATES PREPARED BY:

SELSER SCHAEFER ARCHITECTS

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REVISION	BY	DATE	PLAN SCALE:	DRAWN	DS	08.15.16	APPROVED:
1		11.17.16	RE: DRAWINGS	DESIGNED	AJW		
				SURVEY			
			PROFILE SCALE:	PROJ. MGR.			
			N/A	LEAD ENG.			
			HORIZONTAL:	FIELD MGR.			
			N/A	RECOMMENDED:			
			VERTICAL:	DESIGN MANAGER			
			N/A				
			FILE:	DRAWING:			
			ATLAS PAGE NO.:				
			SHEET NAME: FIXTURE SCHEDULE				

[Signature]
DATE 11/23/16
CITY ENGINEER

SHEET 26 OF 29 SHEETS
SHEET NO.: E003

