

PROJECT MANUAL

DIVISIONS 01 THRU 32

UNLV QAL BUILDING
INTERIOR RENOVATION

100% CONSTRUCTION DOCUMENTS
NOVEMBER 2, 2017

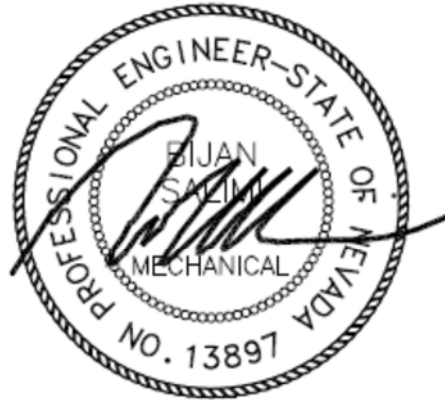
PROJECT MANUAL

DIVISIONS 01 THRU 14 & 31, 32

UNLV QAL BUILDING
INTERIOR RENOVATION

100% CONSTRUCTION DOCUMENTS
NOVEMBER 2, 2017



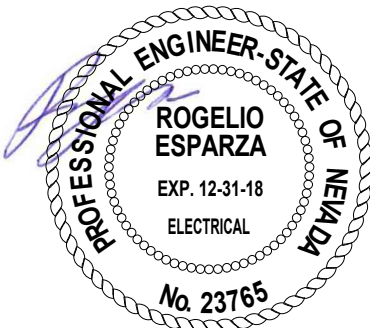
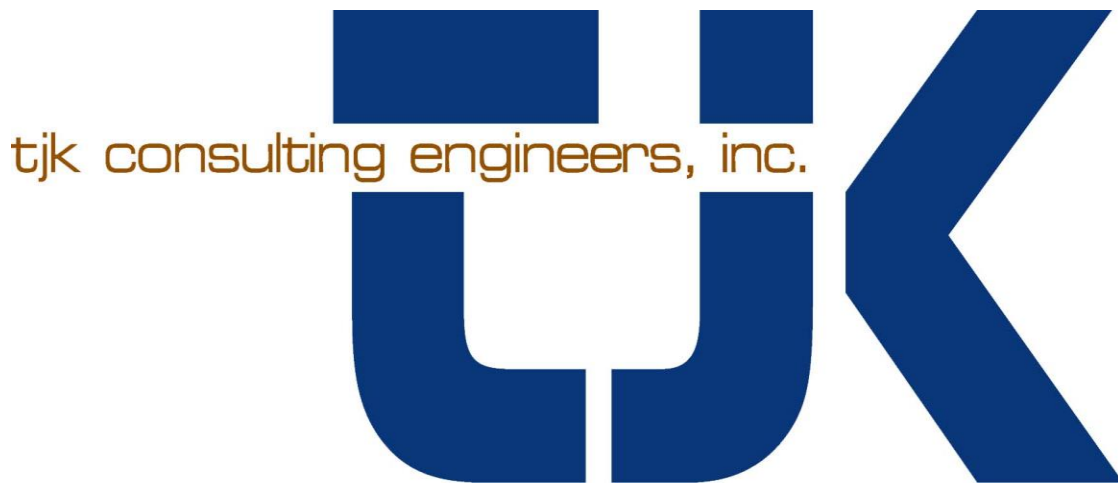


DATE: 11/02/2017
EXP. DATE: 06/30/18

Mechanical & Plumbing Engineer
Sigma Mechanical Engineering, Inc.
Bijan Salimi, P.E., CEM

Division 22 & 23

UNLV QAL BUILDING COVER SHEET



November 2, 2017

DIVISION 26 – ELECTRICAL DIVISION 27 – LOW VOLTAGE DIVISION 28 – ELECTRONIC SAFETY & SECURITY SPECIFICATIONS

TABLE OF CONTENTS**DIVISION 1 – GENERAL REQUIREMENTS**

01 11 00	Summary of Work
01 29 13	Request for Interpretation
01 29 73	Schedule of Values
01 31 13	Project Coordination
01 31 19	Project Meetings
01 31 32	Asbestos and Lead Paint Report (For Information Only)
Final Reports, EPA Las Vegas Environmental Due Diligence Process (EDDP), Asbestos Consulting Services, Program Operations Support (POS) Building and Quality Assurance Laboratory (QAL) Building, by Booz Allen Hamilton Inc., dated November 9, 2015.	
01 32 16	Construction Project Schedule
01 32 33	Photographic Documentation
01 33 00	Submittal Procedures
01 33 23	Shop Drawings, Product Data and Samples
01 35 16	Alteration Project Procedures
01 35 26	Safety and Environmental Requirements
01 40 00	Quality Control
01 42 19	Reference Standards
01 43 26	Testing and Inspecting Agency
01 66 00	Product Storage and Handling Requirements
01 73 29	Cutting and Patching
01 74 13	Progress Cleaning
01 74 19	Construction Waste Management
01 74 23	Final Cleaning
01 75 00	Starting and Adjusting
01 75 10	Demonstration and Training
01 77 00	Closeout Procedures
01 78 23	Operation and Maintenance Data
01 78 36	Warranties
01 78 39	Project Record Documents
01 78 43	Spare Parts and Extra Materials

DIVISION 2 – EXISTING CONDITIONS

02 00 00	Site Preparation
02 41 00	Selective Demolition
02 41 15	Landscape Demolition

DIVISION 3 – CONCRETE

03 11 00	Concrete Forming
03 20 00	Concrete Reinforcing
03 30 00	Cast-In-Place Concrete
03 35 00	Concrete Finishing
03 39 00	Concrete Curing

DIVISION 4 – MASONRY

04 05 16	Masonry Mortaring and Grouting

DIVISION 5 – METALS

05 40 00	Cold Formed Metal Framing
05 50 00	Metal Fabrications

05 52 00 Metal Railings

DIVISION 6 – WOOD, PLASTICS, AND COMPOSITES

06 20 00 Finish Carpentry

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

07 21 16 Blanket Insulation

07 21 19 Foamed-In-Place Insulation

07 84 00 Firestopping

07 90 00 Joint Protection

DIVISION 8 – OPENINGS

08 11 13 Hollow Metal Doors and Frames

08 14 00 Wood Doors

08 31 13 Access Doors and Frames

08 71 00 Finish Hardware

08 80 00 Glazing

DIVISION 9 – FINISHES

09 21 16 Gypsum Board Assemblies

09 24 00 Portland Cement Plaster

09 30 13 Ceramic Tiling

09 51 13 Acoustical Panel Ceilings

09 65 19 Resilient Flooring and Base

09 65 19.33 Rubber Tile Flooring

09 68 13 Carpet Tile

09 77 10 Fabric-Wrapped Acoustic Wall Panel

09 90 00 Painting and Coating

DIVISION 10 – SPECIALTIES

10 11 00 Visual Display Surfaces

10 21 13 Solid Color Reinforced Composite Toilet Compartments

10 21 23 Cubicle Curtains

10 28 00 Toilet Accessories

DIVISION 11 – NOT USED

DIVISION 12 – FURNISHINGS

12 21 24 Manual Roller Shades

12 35 53 Metal Laboratory Casework

12 36 53 Laboratory Worksurfaces

12 36 61 Solid Surfacing Countertops

DIVISION 21 – FIRE SUPPRESSION

DIVISION 22 - PLUMBING

22 05 00 Plumbing General Requirements

22 05 23 General Duty Valves for Plumbing Piping

22 05 29 Hangers and Supports for Plumbing Systems

22 05 53 Identification for Plumbing Piping and Equipment

22 07 00 Plumbing Insulation

UNLV QAL Building Renovation

November 2, 2017

100% Construction Documents

TABLE OF CONTENTS

00 01 10 Page 2

22 11 16	Domestic Water Piping
22 11 19	Domestic Water Piping Specialties
22 11 26	Facility Natural Gas Piping
22 13 16	Sanitary Waste and Vent Piping
22 13 19	Sanitary Waste Piping Specialties
22 63 13	Gas Piping For Laboratory

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

23 05 00	Mechanical General Requirements
23 05 13	Common Motor Requirements for HVAC Equipment
23 05 29	Hangers and Supports for Mechanical Systems
23 05 48	Vibrations and Seismic Controls for HVAC Equipment
23 05 53	Identification for HVAC Equipment
23 05 93	Testing, Adjusting and Balancing
23 07 00	HVAC Insulation
23 21 14	Condensate Drain Piping
23 23 00	Refrigerant Piping and Specialties
23 31 13	Metal Ducts
23 33 00	Air Duct Accessories
23 33 10	Air Duct Cleaning
23 34 16	Centrifugal HVAC Fans
23 37 13	Diffusers, Registers and Grilles
23 41 00	Particulate Air Filtration
23 51 13	Draft Control Devices
23 81 26	Split System Air Conditioners

DIVISION 26 – ELECTRICAL

26 00 00	Basic Electrical Requirements
26 05 05	Selective Demolition for Electrical
26 05 19	Low-Voltage Electrical Power Conductors and Cables
26 05 22	Manufactured Wiring Assemblies
26 05 26	Grounding and Bonding for Electrical Systems
26 05 29	Hangers and Support for Electrical Systems
26 05 33	Raceway and Boxes for Electrical Systems
26 05 36	Cable trays for Electrical Systems
26 05 53	Identification for Electrical Systems
26 22 00	Low-Voltage Transformers
26 24 16	Panel Boards
26 27 16	Electrical Cabinet and Enclosures
26 27 26	Wiring Devices
26 28 26	Enclosed Transfer Switches
26 29 16	Enclosed Contactors
26 32 13	Engine Generators
26 51 50	Interior Lighting – Solid State Lighting (SSL)

DIVISION 27 – LOW VOLTAGE

27 00 00	Communications Requirements
27 05 26	Grounding And Bonding For Communications Systems
27 05 28	Pathways For Communications Systems
27 05 36	Cable Trays For Communications Systems
27 05 44	Sleeves And Sleeve Seals For Communications Pathways
27 11 00	Communications Equipment Room Fittings
27 13 00	Backbone_ Cabling
27 15 00	Communications Horizontal Cabling
27 15 43	Faceplates And Connectors

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 31 00	Fire Detection and Alarm Systems
228 52 11	Detentional Monitoring and Control Systems

Refer to [HTTP://OIT.UNLV.EDU/SITES/DEFAULT/FILES/CAMPUS_WIRING_STANDARDS_8-26-15_1.PDF](http://oit.unlv.edu/sites/default/files/campus_wiring_standards_8-26-15_1.pdf) for UNLV Standards of specs.

DIVISION 31 – EARTHWORK

31 00 00	Earthwork
31 23 16.13	Trenching

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 31 13	Chain Link Fences and Gates

END OF TABLE OF CONTENTS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work by the Owner.
- B. Owner furnished Products.
- C. Contractor use of site.
- D. Owner occupancy.

1.02 WORK BY OWNER

- A. Any items noted NIC (Not in Contract) will be supplied and installed by Owner following Substantial Completion of the Work.
- B. Any items noted OFCI (Owner Furnished Contractor Installed) will be supplied by the Owner and installed by the Contractor.

1.03 OWNER FURNISHED PRODUCTS

- A. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed Shop Drawings, Product Data, and Samples, to Contractor.
 - 2. Arrange and pay for Product delivery to site.
 - 3. On delivery, inspect Products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections and service.
- B. Contractor's Responsibilities:
 - 1. Review Owner reviewed Shop Drawings, Product Data, and Samples.
 - 2. Receive and unload Products at site; inspect for completeness or damage, jointly with Owner.
 - 3. Handle, store, install and finish Products.
 - 4. Repair or replace items damaged after receipt.

1.04 CONTRACTOR USE OF SITE

- A. The Contractor shall have full use of the areas indicated on the Drawings as being within the contract limit line, except for the following:
 - 1. Work along corridor connection between the EPA occupied portion of the building and the existing restrooms. This area will be of the contractor full use only during the construction phase dedicated for this corridor.
 - 2. Work on the existing Restrooms. This area will be of the contractor full use only during the construction phase dedicated for these spaces.
 - 3. Work in front of existing entry doors of the building currently providing direct access to the EPA portion of the building. These areas of work will need to be coordinated in detail with the Owner and EPA. This area will be of the contractor full use only during the construction phase dedicated for this work.
- B. Haulage Routes and Staging Areas: Limited to those approved by Owner.

- C. Construction Operations: Limited to areas noted on Drawings, unless revised by written agreement with Owner.
 - D. All areas adjacent to the contract limit line will be occupied by normal pedestrian and vehicular traffic.
- 1.05 OWNER OCCUPANCY
- A. Cooperate with Owner to facilitate Owner's inspections and any Owner installation.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

REQUESTS FOR INTERPRETATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Administrative and procedural requirements for handling and processing Requests for Interpretation (RFI).
- B. RFI Form: Submit to Architect for approval prior of using it for request of interpretation submittals.
- C. Direct questions during bidding phase as indicated in bidding and/or Contract Documents.

1.02 DEFINITIONS

- A. RFI: Formal process used during construction phase to facilitate communication between Contractor and Architect or Owner's Representative with regard to requests for additional information and clarification of intent of Contract Documents (Drawings and Specifications).

1.03 PROCEDURE

- A. When conditions require clarification of Contract Documents, comply with the following:
 - 1. Subcontractors, manufacturers, and suppliers shall submit request for additional information and clarification to Contractor.
 - 2. Contractor shall contact Architect with requests for interpretation or additional information using the attached form. Architect will **not** accept requests for interpretation or information submitted directly from subcontractors, manufacturers, or suppliers.
 - 3. Architect will provide response to Contractor.
 - 4. Generate RFI by one source per project and number accordingly. Independent numbering system will be used before awarding and after awarding the project.
 - 5. Submit one request for information or clarification per form. Indicate specification section, inclusive of pertinent paragraph and/or sub-sections and/or associated construction document drawings sheet inclusive of pertinent drawing reference number.
- B. Architect will review RFI from Contractor with reasonable promptness and Contractor will be notified in writing of decisions made within ten (10) calendar days. Contractor will state response date for any priority RFIs.
- C. Architect's written response to RFI shall not be considered as a Pricing Order or Pricing Directive, nor does it authorize changes in Contract Sum or Contract Schedule.
- D. Contractor shall maintain a log of RFIs sent to, and responses from, Architect. This log shall be presented during each meeting with the Owner and/ or Architect.
- E. Contractor shall make every reasonable effort to answer questions pertaining to Construction Documents before submitting an RFI.

1.04 RFI FORM

- A. Submit RFIs on approved form. Architect will not respond unless the approved form is used.
- B. If submittal form or format does not provide space needed for complete information, additional sheets may be attached.

PART 2	PRODUCTS Not Used
PART 3	EXECUTION Not Used

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Format.
- B. Detail.
- C. Updating.
- D. Submittals.

1.02 RELATED SECTIONS

- A. Section 01 11 00 - Summary of Work.
- B. Section 01 26 00 - Contract Modification.
- C. Section 01 29 00 - Payment Procedures.
- D. Section 01 32 16 - Construction Progress Schedule.
- E. Section 01 33 00 - Submittal Procedures.

1.03 FORMAT - SCHEDULE OF VALUES

- A. Submit on an original AIA Form G703 (Continuation Sheet).
- B. Separate values of the work by phases and/or areas of the Project.
- C. Include the following project identification:
 - 1. Project number, Project name/location.
 - 2. Phase name and location as appropriate.
 - 3. Contractor's name and address.
 - 4. Date of submittal.

1.04 DETAIL - SCHEDULE OF VALUES

- A. Submit a detailed Schedule of Values to satisfy the Owner's requirements.
- B. Prepare in detailed form and supported by such data to substantiate accuracy.
- C. Each item in the Schedule of Values shall be complete to include its cost and its proper share of overhead and profit and shall aggregate the total Contract Sum.
- D. Each item in the Schedule of Values shall be provided for materials which could be billed as materials stored on site and subsequent installation costs for materials.
- E. Include separate line items for the completed CPM baseline project schedule, and closeout requirements.
- F. Include line items for completion of the following items:
 - 1. Baseline Schedule.
 - 2. Storm Water Pollution Permit full value.
 - 3. Landscape Maintenance full value.

4. Spare Parts and Maintenance Materials.
5. Operation and Maintenance Data (Manuals).
6. As-Builts and Project Record Documents.
7. Systems Demonstration Mechanical.
8. Systems Demonstration Electrical.
9. Systems Demonstration Fire Alarm and Low Voltage.

- G. Include separate line items for principal subcontract amounts.
- H. Include separate line items for the cost of the materials, and for subsequent installation costs for the materials when Application of Payment includes materials or equipment purchased or fabricated and stored, but not yet installed.
- I. Include separate line items for temporary facilities and other major cost items that are not direct cost of actual work-in-place.
- J. Include separate items for each activity indicated by specifications sections from Divisions 2 through 32.

1.05 UPDATING - SCHEDULE OF VALUES

- A. Update and resubmit the Schedule of Values when Change Orders result in a change in the Contract Sum.

1.06 SUBMITTALS

- A. Submit the proposed Schedule of Values prior to the Pre-Construction Conference. Provide a copy to both the Owner and Architect for review.
- B. Participate in the review of proposed Schedule of Values jointly with the Owner and Architect as requested.
- C. Revise to incorporate all comments from the review.
- D. Resubmit, as required, within five (5) days after the review notice.
- E. The Owner and Architect must accept the Schedule of Values before the Contractor may submit the first Application for Payment.
- F. The accepted Schedule of Values shall be used as a basis for reviewing monthly Applications for Payment.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

- A. Contractor shall not submit a front-loaded Schedule of Values.
- B. Prepare the Schedule of Values in coordination with Contractor's Construction Schedule.

END OF SECTION

SECTION 01 31 13

PROJECT COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Coordination of Work.

1.02 RELATED SECTIONS

- A. Section 01 25 13 - Product Substitution Procedures.
- B. Section 01 31 19 - Project Meetings.
- C. Section 01 32 16 - Construction Progress Schedule.
- D. Section 01 33 00 - Submittal Procedures.
- E. Section 01 33 23 - Shop Drawings, Product Data, and Samples.
- F. Section 01 40 00 - Quality Control.
- G. Section 01 66 00 - Product Storage and Handling Requirements.
- H. Section 01 77 00 - Closeout Procedures.

1.03 DESCRIPTION

- A. Coordinate scheduling, submittals, and Work of the various sections of specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.

1.04 MEETINGS

- A. Hold coordination meetings with personnel and subcontractors to assure coordination of Work.

1.05 COORDINATION OF SUBMITTALS

- A. Schedule and coordinate submittals specified in Section 01 33 00.
- B. Coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

1.06 COORDINATION OF SPACE

- A. Coordinate use of project space and sequence of installation of mechanical and electrical Work which is indicated diagrammatically on drawings. Follow routings shown for pipes, ducts, and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- B. In finished areas except as otherwise shown, conceal pipes, ducts, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.
- C. Coordinate Construction Phasing as required to maintain in operation the use of the existing restroom facilities by other portions of the building not part of this renovation. Supply

provisional restroom facilities for the exclusive use of the building users from the portion of the building not being part of this renovation work, while the renovation work takes place at the restrooms, in the proximity of them or at the corridors providing access to the restrooms. The construction phasing plans need to be approved by AHJ, owner and architect prior to commence any of the renovation work.

1.07 COORDINATION OF CONTRACT CLOSEOUT

- A. Coordinate completion and cleanup of Work of separate sections in preparation for Substantial Completion.
- B. After Owner occupancy of premises, coordinate access to site by various sections for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- C. Assemble and coordinate closeout submittals specified in Section 01 77 00.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PROJECT MEETINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality Assurance.
- B. Schedule Review Conference.
- C. Pre-Construction Conference.
- D. Project Meetings.
- E. Pre-Closeout Conference.
- F. Coordination Meetings.

1.02 RELATED SECTIONS

- A. Section 01 32 16 - Construction Progress Schedule.

1.03 QUALITY ASSURANCE

- A. Persons designated by the Contractor to attend and participate in conferences and/or project meetings shall have the authority to commit the Contractor to solutions agreed upon in the conference and/or project meetings.
- B. The following list is not inclusive of the Contractor's requirement to attend other conferences and/or meetings as specified elsewhere in this project manual or conference and/or meetings as requested by the Owner and/or Architect.

1.04 SCHEDULE REVIEW CONFERENCE

- A. The Contractor shall participate in a Schedule Review Conference with the Owner and Architect. Time, agenda and subsequent requirements resulting from this conference shall be as provided in the Conditions of the Contract and Owner-Construction Manager as Constructor Agreement.

1.05 PRE-CONSTRUCTION CONFERENCE

- A. Within seven days from the Notice of to Proceed, the Contractor, including the Project superintendent and major subcontractors, shall attend a Pre-Construction Conference with the Owner and Architect. Location of this conference to be as agreed upon by Owner, Architect and Contractor.
- B. Discuss items of significance that could affect progress, including the following:
 - 1. Tentative construction schedule
 - 2. Critical work sequencing
 - 3. Designation of responsible personnel
 - 4. Procedures for processing field decisions and Change Orders
 - 5. Procedures for processing Applications for Payment
 - 6. Distribution of Contract Documents
 - 7. Submittal of Shop Drawings, Product Data, and Samples
 - 8. Preparation of record documents
 - 9. Use of the premises
 - 10. Parking availability

11. Office, work, and storage areas
12. Equipment deliveries and priorities
13. Safety procedures
14. First aid
15. Security
16. Housekeeping
17. Working hours

- C. The Contractor shall prepare minutes from the conference and make distribution to all attendees.

1.06 PROJECT MEETINGS

- A. The Contractor shall attend regularly scheduled project meetings with the Owner and Architect. Such meetings shall be held once each week unless determined otherwise by the Owner and Architect. Project meetings shall be held at the project site or at location determined by the Owner. The date of the first project meeting shall be established at the Pre-Construction conference jointly by the Owner, Architect and Contractor.
- B. In addition to representatives of the Owner, General Contractor and the Architect, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination, or performance of future activities may be represented at these meetings.
- C. The Contractor shall prepare minutes from each project meeting and make distribution to all attendees.

1.07 PRE-CLOSEOUT CONFERENCE

- A. The Contractor and his major subcontractors shall attend a pre-closeout conference with the Owner and Architect to review and schedule the contractual obligations such as the substantial completion inspection, punch list, temporary certificate of occupancy, certificate of occupancy, final cleaning, project record documents, operations and maintenance data, spare parts, closeout certificates and warranty period.
- B. Notify the Owner and Architect fifteen (15) days prior to the anticipated courtesy inspection.
- C. The Contractor shall prepare minutes from the conference and shall make distribution to all attendees.

1.08 OTHER CONFERENCES AND COORDINATION MEETINGS

- A. The Contractor shall attend other conferences and coordination meetings with the Owner and Architect as requested.
- B. Project coordination meetings are in addition to specific conferences held for other purposes, such as regular project meetings and special pre-installation conferences.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 31 32
FOR INFORMATION DOCUMENTS

Booz Allen Hamilton Inc.
8283 Greensboro Drive
McLean, VA 22102

511 Davis Drive, Suite 400
Morrisville, NC 27560

Tel 1 919 472 5314
Fax 1 919 472 5303

www.boozallen.com

November 9, 2015

U.S. Environmental Protection Agency
Office of Research and Development (ORD)
National Exposure Research Laboratory (NERL)
109 T.W. Alexander Drive
Mail Code D305-01
Research Triangle Park, NC 277089

Attn: Ms. Beverly McKim, Task Order Project Officer

Subject: Final Reports, EPA Las Vegas Environmental Due Diligence Process (EDDP), Asbestos Consulting Services, Program Operations Support (POS) Building and Quality Assurance Laboratory (QAL) Building

Dear Ms. McKim:

Booz Allen Hamilton is pleased to submit the Final Reports for the EPA Las Vegas EDDP Asbestos Consulting Services for the POS and QAL Buildings. Booz Allen welcomes all questions and feedback on this material, and looks forward to continuing to support this project.

Sincerely,



Justin Nyland, PE, LEED AP
Program Manager

BOOZ ALLEN HAMILTON INC.

Cc: Steve Gardner, EPA Alternate Task Order Project Officer

Attachments: EPA Las Vegas EDDP, Asbestos Consulting Services, Final Reports for the POS and QAL Buildings (pdf)

November 2, 2015

Mr. Santiago Vila
Amec Foster Wheeler Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, NC 27703

Subject: **Asbestos Consulting Services**
EPA Harmon Avenue Complex
Program Operations Staff (POS) Building
Rooms 15 and 30
944 East Harmon Avenue
Las Vegas, Nevada

Dear Mr. Vila:

In accordance with your request and authorization of services under the *Short Form Laboratory Services Subcontract Agreement* dated September 8, 2015, Infinity Environmental Services, LLC (Infinity) of Las Vegas, Nevada, collected three bulk samples of suspect asbestos containing building materials from room 30 on October 19, 2015, and on October 21, 2015, collected three samples from room 15 of the subject building located in Las Vegas, Nevada. Mr. Steven Havens, the owner of Infinity and a Nevada licensed asbestos abatement consultant (building inspector), conducted the sampling survey. The suspect asbestos containing materials (ACMs) homogenous areas identified and sampled during the course of our investigation consisted of wall plaster and surfacing.

The samples were analyzed by Forensic Analytical Laboratories, Inc. (FALI) located in Las Vegas, Nevada. FALI is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis. The samples submitted for primary testing were analyzed by Polarized Light Microscopy (PLM). The analytical reports are enclosed.

The results of our survey and the laboratory analyses are summarized as follows:

Sample ID	Sampling Locations and Materials Sampled	Laboratory Results
POS 30 - PW - 01	Room 30, North Side Wall: Layer 1: Beige Plaster Layer 2: White Cementitious Material Layer 3: Paint	Layer 1: ND Layer 2: ND Layer 3: ND
POS 30 - PW - 02	Room 30, South Side Wall: Layer 1: Beige Plaster Layer 2: White Cementitious Material Layer 3: Paint	Layer 1: ND Layer 2: ND Layer 3: ND
POS 30 - PW - 03	Room 30, West Side Wall: Layer 1: Beige Plaster Layer 2: White Cementitious Material Layer 3: Paint	Layer 1: ND Layer 2: ND Layer 3: ND
POS - PW - 04	Room 15, West Side Wall: Layer 1: Off-White Plaster Layer 2: White Non-Fibrous Material Layer 3: Paint	Layer 1: ND Layer 2: ND Layer 3: ND
POS - PW - 05	Room 15, South Side Wall: Layer 1: Off-White Plaster Layer 2: White Non-Fibrous Material Layer 3: Paint	Layer 1: ND Layer 2: ND Layer 3: ND
POS - WP - 06	Room 15, East Side Wall: Layer 1: Beige Plaster Layer 2: White Cementitious Material Layer 3: Paint	Layer 1: ND Layer 2: ND Layer 3: ND

ND = No Asbestos was Detected in the Sample and/or Layer Collected

Based on the laboratory results, the laboratory is reporting no asbestos detected in the samples collected.

This report is for the use of Amec Foster Wheeler Environment & Infrastructure, Inc., Booz Allen Hamilton, Inc., and the Environmental Protection Agency as it applies to the above mentioned building in Las Vegas, Nevada. Infinity is not responsible for any claims or damages associated with interpretation of available information. This assessment should not be regarded as a guarantee that no further asbestos, beyond that which was suspected to be present (and sampled) during our investigation, is present at the property. In addition, asbestos is usually not distributed uniformly throughout a material and Infinity cannot guarantee that the areas sampled are exactly as represented throughout the property.

We thank you for this opportunity to be of service. If you have any questions regarding the information provided in this report, please call the undersigned.

Sincerely,

Infinity Environmental Services, LLC



Steven Havens

Owner

Nevada Asbestos Abatement Consultant License No. IM-472

Encl: Infinity, Material Data Chain of Custody Forms, Asbestos
Forensic Analytical, Laboratory Reports, Asbestos
Asbestos Abatement Consultant License

9594 Newton Grove Court, Las Vegas, Nevada 89148

Infinity Inspector Steven Havens	Project Name EPA - POS Building	Project Number 15-0531-01	Date Sampled 10-19-15
Infinity Contact Steven Havens	Project Location UNLV	Analysis Type Asbestos Bulk (PLM)	Instructions:
Infinity Phone Number (702) 449-1479	Infinity Email Lvhavens@gmail.com	Turn Around Time Same Day	
SAMPLE ID	MATERIAL DESCRIPTION	SAMPLE LOCATION	SAMPLE NOTES
POS 30 - PW - 01	Wall Surfacing and Plaster	North Wall in Room 30	
POS 30 - PW - 02	Wall Surfacing and Plaster	South Wall in Room 30	
POS 30 - PW - 03	Wall Surfacing and Plaster	West Wall in Room 30	

MATERIAL	CONDITION	UNITS	ASBESTOS
PFI - Pipe Fitting Insulation PPI - Pipe Part Insulation PEI - Pipe Elbow Insulation PI - Pipe Insulation TSI - Thermal System Insulation FP - Fire Proofing BI - Boiler Insulation	G - Good (No maintenance is required currently) <10% Damaged (Some repair needed) D - Significantly Damaged (Repair or replace ASAP) SD -	LF - Linear Ft SF - Square Ft CF - Cubic Ft	A = Amosite Ch = Chrysotile
FT - Floor Tile FTM - Floor Tile Mastic SF - Sheet Flooring CB - Cove Base CBM - Cove Base Adhesive ACT - Acoustical Ceiling Tile ACS - Acoustical Ceiling Spray	WT - Wall Texture WP - Wall Plaster DW - Drywall JC - Joint Compound RM - Roofing Material S - Stucco X - Miscellaneous Debris		

Relinquished By: Steven Havens

Date/Time: 10-20-15

Received By: P. Williams

Relinquished By: _____

Date/Time: _____

Received By: _____

10/20/15 8:30am



Bulk Asbestos Analysis

(EPA Method 600/R-93-116, Visual Area Estimation)

Infinity Environmental Services
Steve Havens
9594 Newton Grove Court

Las Vegas, NV 89148

Client ID: L1234
Report Number: B212087
Date Received: 10/20/15
Date Analyzed: 10/20/15
Date Printed: 10/20/15
First Reported: 10/20/15

Job ID/Site: 15-0531-01, EPA-POS Building, UNLV

FALI Job ID: L1234

Date(s) Collected: 10/19/2015

Total Samples Submitted: 3

Total Samples Analyzed: 3

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
POS 30-PW-01	01105520						
Layer: Beige Plaster			ND				
Layer: White Cementitious Material			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Comment: North Wall in Room 30							
POS 30-PW-02	01105521						
Layer: Beige Plaster			ND				
Layer: White Cementitious Material			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Comment: South Wall in Room 30							
POS 30-PW-03	01105522						
Layer: Beige Plaster			ND				
Layer: White Cementitious Material			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Comment: West Wall in Room 30							

Rachel Kolberg, Laboratory Analyst, Las Vegas Laboratory

Note: Limit of Quantification ('LOQ') = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

Analytical results and reports are generated by Forensic Analytical Laboratories Inc. (FALI) at the request of and for the exclusive use of the person or entity (client) named on such report. Results, reports or copies of same will not be released by FALI to any third party without prior written request from client. This report applies only to the sample(s) tested. Supporting laboratory documentation is available upon request. This report must not be reproduced except in full, unless approved by FALI. The client is solely responsible for the use and interpretation of test results and reports requested from FALI. Forensic Analytical Laboratories Inc. is not able to assess the degree of hazard resulting from materials analyzed. FALI reserves the right to dispose of all samples after a period of thirty (30) days, according to all state and federal guidelines, unless otherwise specified. All samples were received in acceptable condition unless otherwise noted.

9594 Newton Grove Court, Las Vegas, Nevada 89148

CHAIN OF CUSTODY FORM

Infinity Inspector Steven Havens	Project Name EPA - POS Building	Project Number 15-0531-01	Date Sampled 10-21-15
Infinity Contact Steven Havens	Project Location UNLV	Analysis Type Asbestos Bulk (PLM)	Instructions:
Infinity Phone Number (702) 449-1479	Infinity Email Lvhavens@gmail.com	Turn Around Time Same Day	
SAMPLE ID	MATERIAL DESCRIPTION	SAMPLE LOCATION	SAMPLE NOTES
POS - PW - 04	Wall Surfacing, Plaster	West Side of Room 15	
POS - PW - 05	Wall Surfacing, Plaster	South Side of Room 15	
POS - PW - 06	Wall Surfacing, Plaster	East Side of Room 15	

MATERIAL		CONDITION	UNITS	ASBESTOS
PFI - Pipe Fitting Insulation PPI - Pipe Part Insulation PEI - Pipe Elbow Insulation PI - Pipe Insulation TSI - Thermal System Insulation FP - Fire Proofing BI - Boiler Insulation	FT - Floor Tile FTM - Floor Tile Mastic SF - Sheet Flooring CB - Cove Base CBM - Cove Base Adhesive ACT - Acoustical Ceiling Tile ACS - Acoustical Ceiling Spray	WT - Wall Texture WP - Wall Plaster DW - Drywall JC - Joint Compound RM - Roofing Material S - Stucco X - Miscellaneous Debris	LF - Linear Ft SF - Square Ft CF - Cubic Ft	A = Amosite Ch = Chrysotile
Relinquished By: <u>Steven Havens</u> Date/Time: <u>10-22-15</u> Received By: <u>[Signature]</u> <u>10/22/15 8:55am</u>		Relinquished By: _____ Date/Time: _____ Received By: _____		



Bulk Asbestos Analysis

(EPA Method 600/R-93-116, Visual Area Estimation)

Infinity Environmental Services
Steve Havens
9594 Newton Grove Court

Las Vegas, NV 89148

Client ID: L1234
Report Number: B212212
Date Received: 10/22/15
Date Analyzed: 10/22/15
Date Printed: 10/30/15
First Reported: 10/22/15

Job ID/Site: 15-0531-01, EPA-POS Building, UNLV**FALI Job ID:** L1234**Date(s) Collected:** 10/21/2015**Total Samples Submitted:** 3**Total Samples Analyzed:** 3

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
POS-PW-04	01105857						
Layer: Off-White Plaster			ND				
Layer: White Non-Fibrous Material			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (5 %)							
Comment: West Side of Room 15							
POS-PW-05	01105858						
Layer: Off-White Plaster			ND				
Layer: White Non-Fibrous Material			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (20 %) Fibrous Glass (10 %)							
Comment: South Side of Room 15. Identified as "Wall Surfacing, Plaster" on COC							
POS-PW-06	01105859						
Layer: Off-White Plaster			ND				
Layer: White Non-Fibrous Material			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (5 %)							
Comment: East Side of Room 15							

Rachel Kolberg, Laboratory Analyst, Las Vegas Laboratory

Note: Limit of Quantification ('LOQ') = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

Analytical results and reports are generated by Forensic Analytical Laboratories Inc. (FALI) at the request of and for the exclusive use of the person or entity (client) named on such report. Results, reports or copies of same will not be released by FALI to any third party without prior written request from client. This report applies only to the sample(s) tested. Supporting laboratory documentation is available upon request. This report must not be reproduced except in full, unless approved by FALI. The client is solely responsible for the use and interpretation of test results and reports requested from FALI. Forensic Analytical Laboratories Inc. is not able to assess the degree of hazard resulting from materials analyzed. FALI reserves the right to dispose of all samples after a period of thirty (30) days, according to all state and federal guidelines, unless otherwise specified. All samples were received in acceptable condition unless otherwise noted.

STATE OF NEVADA
DEPARTMENT OF BUSINESS AND INDUSTRY
DIVISION OF INDUSTRIAL RELATIONS
Occupational Safety and Health Administration
Asbestos Control Program

 Certifies That Steven Havens
Infinity Environmental Services LLC
is Licensed As Asbestos Abatement Consultant

License No. IM-472

Expiration Date 06/23/2016

Signature Of Licensee



November 3, 2015

Mr. Santiago Vila
Amec Foster Wheeler Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, NC 27703

Subject: **Asbestos Consulting Services**

EPA Harmon Avenue Complex
Quality Assurance Laboratory (QAL) Building
Asbestos Samples Collected - Rooms 18, 21, and 4
Asbestos Inspections Without Sampling - Rooms 20, 22, and 25
944 East Harmon Avenue
Las Vegas, Nevada

Dear Mr. Vila:

In accordance with your request and authorization of services under the *Short Form Laboratory Services Subcontract Agreement* dated September 8, 2015, Infinity Environmental Services, LLC (Infinity) of Las Vegas, Nevada, collected twenty-one bulk samples of suspect asbestos containing building materials samples on October 19, 2015 from the above mentioned rooms of the subject building located in Las Vegas, Nevada. Mr. Steven Havens, the owner of Infinity and a Nevada licensed asbestos abatement consultant (building inspector), conducted the sampling survey. The suspect asbestos containing materials (ACMs) homogenous areas identified and sampled during the course of our investigation consisted of the following: 1" x 1" ceramic floor tiles with black mastic, ceramic floor tile grout, thin set concrete (located under the ceramic floor tiles), 12" x 12" floor tiles with yellow mastic, and 9" x 9" floor tiles with black mastic.

The samples were analyzed by Forensic Analytical Laboratories, Inc. (FALI) located in Las Vegas, Nevada. FALI is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis. The samples submitted for primary testing were analyzed by Polarized Light Microscopy (PLM). The analytical report is enclosed.

The results of our survey and the laboratory analyses are summarized as follows:

Sample ID	Sampling Locations and Materials Sampled	Laboratory Results
QAL 18 - CT - 01	Room 18, Middle of the Floor: Layer 1: 1" x 1" Burgundy with White Spots Ceramic Layer 2: Black Mastic	Layer 1: ND Layer 2: ND
QAL 18 - CT - 02	Room 18, Middle of the Floor: Layer 1: 1" x 1" Burgundy with White Spots Ceramic Layer 2: Black Mastic	Layer 1: ND Layer 2: ND
QAL 18 - CT - 03	Room 18, Middle of the Floor: Layer 1: 1" x 1" Burgundy with White Spots Ceramic Layer 2: Black Mastic	Layer 1: ND Layer 2: ND
QAL 18 - CT - 04	Room 18, Under the Cabinet: Layer 1: 1" x 1" Dark Brown with White Spots Ceramic Layer 2: Black Mastic Layer 3: Off-White Woven Material Layer 4: Red-Brown Grout	Layer 1: ND Layer 2: ND Layer 3: ND Layer 4: ND
QAL 18 - CT - 05	Room 18, Under the Cabinet: Layer 1: 1" x 1" Dark Brown with White Spots Ceramic Layer 2: Black Mastic Layer 3: Off-White Woven Material Layer 4: Red-Brown Grout	Layer 1: ND Layer 2: ND Layer 3: ND Layer 4: ND
QAL 18 - CT - 06	Room 18, Under the Cabinet: Layer 1: 1" x 1" Dark Brown with White Spots Ceramic Layer 2: Black Mastic Layer 3: Off-White Woven Material Layer 4: Red-Brown Grout	Layer 1: ND Layer 2: ND Layer 3: ND Layer 4: ND
QAL 18 - TG - 07	Room 18, Middle of the Floor: Ceramic Floor Tile Grout Grey Grout	ND
QAL 18 - TG - 08	Room 18, Middle of the Floor: Ceramic Floor Tile Grout Grey Grout	ND
QAL 18 - TG - 09	Room 18, Middle of the Floor: Ceramic Floor Tile Grout Grey Grout	ND

Sample ID	Sampling Locations and Materials Sampled	Laboratory Results
QAL 18 - TC - 10	Room 18, Middle of the Floor, Under the Ceramic Floor Tile: Thin Set Concrete Tan Cementitious Material	ND
QAL 18 - TC - 11	Room 18, Middle of the Floor, Under the Ceramic Floor Tile: Thin Set Concrete Tan Cementitious Material	ND
QAL 18 - TC - 12	Room 18, Middle of the Floor, Under the Ceramic Floor Tile: Thin Set Concrete Tan Cementitious Material	ND
QAL 21 - FT - 13	Room 21: Layer 1: Grey/White Sheet Flooring Layer 2: Fibrous Backing Non-Fibrous Layer 3: Yellow Mastic Layer 4: 12" x 12" White Floor Tile Layer 5: Yellow Mastic Layer 6: Off-White Backing Non-Fibrous	Layer 1: ND Layer 2: ND Layer 3: ND Layer 4: ND Layer 5: ND Layer 6: ND
QAL 21 - FT - 14	Room 21: Layer 1: Grey/White Sheet Flooring Layer 2: Fibrous Backing Non-Fibrous Layer 3: Yellow Mastic Layer 4: 12" x 12" White Floor Tile Layer 5: Yellow Mastic Layer 6: Off-White Backing Non-Fibrous	Layer 1: ND Layer 2: ND Layer 3: ND Layer 4: ND Layer 5: ND Layer 6: ND
QAL 21 - FT - 15	Room 21: Layer 1: Grey/White Sheet Flooring Layer 2: Fibrous Backing Non-Fibrous Layer 3: Yellow Mastic Layer 4: 12" x 12" White Floor Tile Layer 5: Yellow Mastic Layer 6: Off-White Backing Non-Fibrous	Layer 1: ND Layer 2: ND Layer 3: ND Layer 4: ND Layer 5: ND Layer 6: ND
QAL 21 - FT - 16	Room 21: Layer 1: 12" x 12" Black Floor Tile Layer 2: Yellow Mastic	Layer 1: ND Layer 2: ND

Sample ID	Sampling Locations and Materials Sampled	Laboratory Results
QAL 21 - FT - 17	Room 21: Layer 1: 12" x 12" Black Floor Tile Layer 2: Yellow Mastic	Layer 1: ND Layer 2: ND
QAL 21 - FT - 18	Room 21: Layer 1: 12" x 12" Black Floor Tile Layer 2: Yellow Mastic	Layer 1: ND Layer 2: ND
QAL 4 - FT - 19	Room 4, Middle of the Floor: Layer 1: 9" x 9" Grey and White Floor Tile Layer 2: Black Mastic	Layer 1: 2% Chrysotile Layer 2: 7% Chrysotile
QAL 4 - FT - 20	Room 4, Middle of the Floor Layer 1: 9" x 9" Grey and White Floor Tile Layer 2: Black Mastic	Layer 1: 2% Chrysotile Layer 2: 7% Chrysotile
QAL 4 - FT - 21	Room 4, Under the Cabinet: Layer 1: 9" x 9" Grey and White Floor Tile Layer 2: Black Mastic	Layer 1: 2% Chrysotile Layer 2: 7% Chrysotile

ND = No Asbestos was Detected in the Sample and/or Layer Collected

Current EPA standards define an ACM as... *"any material containing asbestos in excess of one percent (>1%) by weight"*.

Based on the laboratory results and our survey, the laboratory is reporting the samples collected from the 9" x 9" floor tile with black mastic were found to contain in excess of one percent (>1%) asbestos by weight.

The Category II Non Friable and Non Regulated ACM floor tile with black mastic must be abated by a Nevada licensed asbestos abatement contractor in order to comply with Federal, State, and County regulations. After the ACMs have been abated from the subject building, a third party visual and air clearance assessment should be performed by a Nevada OSHA licensed Asbestos Abatement Consultant in order to comply with Nevada Occupational Safety and Health Enforcement Section (OSHES) and Clark County of Air Quality (CCDAQ) regulations.

OSHA regulates worker exposure to airborne asbestos fibers with Permissible Exposure Limits (PELs), and requires that, when disturbing materials containing asbestos, specific work practices and procedures shall be in accordance with 29 CFR 1926.1101. The State of Nevada OSHES protects building occupants and workers from airborne asbestos exposure.

Nevada OSHES and CCDAQ asbestos regulations should be understood and followed during any disturbance of ACMs identified. CCDAQ enforces the EPA NESHAP for asbestos which prohibits visible emissions of asbestos and requires proper disposal of ACM.

Regarding the removal of ACMs found at the subject building, the following steps are recommended to maintain regulatory compliance and minimize liability:

1. A qualified asbestos abatement contractor and workers licensed in the State of Nevada should perform any actions involving the removal of ACMs. Removal activities should conform to local, state, and federal laws, ordinances, and regulations.
2. A qualified asbestos abatement consultant licensed in the State of Nevada should be retained to perform a final visual and air clearance assessment after the abatement activities are performed.
3. Prior to any renovation/demolition activities, notification of the governing agencies (i.e., Nevada OSHES, USEPA, and CCDAQ) regulating the abatement of asbestos will be necessary

Rooms Inspected Without Sampling:

QAL 20 - Concrete floor with an epoxy paint covering.

QAL 22 - Concrete floor with an epoxy paint covering.

QAL 25 - Concrete floor with an epoxy paint covering.

No potential ACMs (i.e. sheet flooring, floor tile, mastic, etc.) were observed in these rooms.

Lead Based Paint Survey:

On October 16, 2015, UNLV performed a survey of the ceramic floor tiles located in room 18 of the QAL building with the use of a Fluorescent X-Ray (XRF).

The results of the XRF lead identification survey are summarized as follows:

Date	Readings	Mode	Pb	Pb +/-
16-Oct-15	BAL 03 soil standard	Soil	76	9
16-Oct-15	Tile 1	Soil	66	18
16-Oct-15	Tile 2	Soil	63	17
16-Oct-15	Tile 3	Soil	<LOD	44
16-Oct-15	Tile 4	Soil	85	19
16-Oct-15	Tile 5	Soil	42	13
16-Oct-15	Tile 6	Soil	53	14
16-Oct-15	Tile 3 duplicate	Soil	57	17
Tiles 1 through 4 are medium red tiles covering the main floor Tiles 5 and 6 are dark red tiles from under the counter				

Lead in Ceramic Tile Findings:

The XRF results indicated lead in the tiles sampled in room 18. Removal or disturbance of material with any detectable amount of lead must be handled in accordance with OSHA regulation 29 CHR 1923.62. Therefore, "negative" XRF readings i.e. those below the HUD/EPA definition of what constitutes Lead (1.0 mg/cm²) **DO NOT** relieve contractors from performing exposure assessments (personal air monitoring) on their employees per the OSHA Permissible Exposure Limit (PEL) depending on the work activities.

During the removal of the subject ceramic floor tiles, extreme care should be used in not allowing the tiles to be broken. The tiles should be kept adequately wet during removal to help alleviate as much dust as possible.

After the tiles have been removed and placed in the proper disposal container, a TCLP test on the waste should be performed by a Nevada Certified Environmental Manager (CEM) to determine the proper disposal method.

Disclaimer

The sampling of the subject ceramic tiles was performed by an employee of UNLV and was not contracted by Infinity to perform the XRF testing. It should be noted that Infinity does not hold a license for the testing of lead containing materials. Therefore, Infinity should not be accountable for the testing results outlined in this report.

This report is for the use of Amec Foster Wheeler Environment & Infrastructure, Inc., Booz Allen Hamilton, Inc., and the Environmental Protection Agency as it applies to the above mentioned building in Las Vegas, Nevada. Infinity is not responsible for any claims or damages associated with interpretation of available information. This assessment should not be regarded as a guarantee that no further asbestos, beyond that which was suspected to be present (and sampled) during our investigation, is present at the property. In addition, asbestos is usually not distributed uniformly throughout a material and Infinity cannot guarantee that the areas sampled are exactly as represented throughout the property.

We thank you for this opportunity to be of service. If you have any questions regarding the information provided in this report, please call the undersigned.

Sincerely,

Infinity Environmental Services, LLC



Steven Havens
Owner

Nevada Asbestos Abatement Consultant License No. IM-472

Encl: Infinity, Material Data Chain of Custody Form, Asbestos
Forensic Analytical, Laboratory Report, Asbestos
Asbestos Abatement Consultant License
Asbestos Site Sampling Map
XRF Sampling Results Table and Photograph Provided by UNLV

Infinity Inspector Steven Havens	Project Name EPA - QAL Building	Project Number 15-0531-01	Date Sampled 10-19-15
Infinity Contact Steven Havens	Project Location UNLV	Analysis Type Asbestos Bulk (PLM)	Instructions:
Infinity Phone Number (702) 449-1479	Infinity Email Lvhavens@gmail.com	Turn Around Time Same Day	
SAMPLE ID	MATERIAL DESCRIPTION	SAMPLE LOCATION	SAMPLE NOTES
QAL 18 - CT - 01	1" x 1" Burgundy with White Spots Ceramic Floor Tile with Black Mastic	Middle of the Floor in Room 18	
QAL 18 - CT - 02	1" x 1" Burgundy with White Spots Ceramic Floor Tile with Black Mastic	Middle of the Floor in Room 18	
QAL 18 - CT - 03	1" x 1" Burgundy with White Spots Ceramic Floor Tile with Black Mastic	Middle of the Floor in Room 18	
QAL 18 - CT - 04	1" x 1" Dark Brown Ceramic Floor Tile with Black Mastic and Grout	Under the Cabinet in Room 18	
QAL 18 - CT - 05	1" x 1" Dark Brown Ceramic Floor Tile with Black Mastic and Grout	Under the Cabinet in Room 18	
QAL 18 - CT - 06	1" x 1" Dark Brown Ceramic Floor Tile with Black Mastic and Grout	Under the Cabinet in Room 18	
QAL 18 - TG - 07	Gray Ceramic Floor Tile Grout	Middle of the Floor in Room 18	

MATERIAL	CONDITION	UNITS	ASBESTOS
PFI - Pipe Fitting Insulation PPI - Pipe Part Insulation PEI - Pipe Elbow Insulation PI - Pipe Insulation TSI - Thermal System Insulation FP - Fire Proofing BI - Boiler Insulation	G - Good (No maintenance is required currently) <10% D - Damaged (Some repair needed) SD - Significantly Damaged (Repair or replace ASAP)	LF - Linear Ft SF - Square Ft CF - Cubic Ft	A = Amosite Ch = Chrysotile
FT - Floor Tile FTM - Floor Tile Mastic SF - Sheet Flooring CB - Cove Base CBM - Cove Base Adhesive ACT - Acoustical Ceiling Tile ACS - Acoustical Ceiling Spray	WT - Wall Texture WP - Wall Plaster DW - Drywall JC - Joint Compound RM - Roofing Material S - Stucco X - Miscellaneous Debris		
Relinquished By: <u>Steven Havens</u> Relinquished By: _____ Date/Time: <u>10-20-15</u> Date/Time: _____ Received By: <u>[Signature]</u> Received By: _____ <u>10/20/15 8:30am</u>			

9594 Newton Grove Court, Las Vegas, Nevada 89148

CHAIN OF CUSTODY FORM

Infinity Inspector Steven Havens	Project Name EPA - QAL Building	Project Number 15-0531-01	Date Sampled 10-19-15
Infinity Contact Steven Havens	Project Location UNLV	Analysis Type Asbestos Bulk (PLM)	Instructions:
Infinity Phone Number (702) 449-1479	Infinity Email Lvhavens@gmail.com	Turn Around Time Same Day	
SAMPLE ID	MATERIAL DESCRIPTION	SAMPLE LOCATION	SAMPLE NOTES
QAL 18 - TG - 08	Gray Ceramic Floor Tile Grout	Middle of the Floor in Room 18	
QAL 18 - TG - 09	Gray Ceramic Floor Tile Grout	Middle of the Floor in Room 18	
QAL 18 - TC - 10	Thin Set Concrete	Under the Ceramic Tiles Middle of Room 18	
QAL 18 - TC - 11	Thin Set Concrete	Under the Ceramic Tiles Middle of Room 18	
QAL 18 - TC - 12	Thin Set Concrete	Under the Ceramic Tiles Middle of Room 18	
QAL 21 - FT - 13	Gray and White Sheet Flooring over 12" x 12" White Floor Tile over Yellow Mastic	Room 21	The Sheet Flooring was Located Throughout the Room
QAL 21 - FT - 14	Gray and White Sheet Flooring over 12" x 12" White Floor Tile over Yellow Mastic	Room 21	
QAL 21 - FT - 15	Gray and White Sheet Flooring over 12" x 12" White Floor Tile over Yellow Mastic	Room 21	

MATERIAL	CONDITION	UNITS	ASBESTOS
PFI - Pipe Fitting Insulation PPI - Pipe Part Insulation PEI - Pipe Elbow Insulation PI - Pipe Insulation TSI - Thermal System Insulation FP - Fire Proofing BI - Boiler Insulation	G - Good (No maintenance is required currently) <10% Damaged (Some repair needed) D - Significantly Damaged (Repair or replace ASAP) SD -	LF - Linear Ft SF - Square Ft CF - Cubic Ft	A = Amosite Ch = Chrysotile
FT - Floor Tile FTM - Floor Tile Mastic SF - Sheet Flooring CB - Cove Base CBM - Cove Base Adhesive ACT - Acoustical Ceiling Tile ACS - Acoustical Ceiling Spray	WT - Wall Texture WP - Wall Plaster DW - Drywall JC - Joint Compound RM - Roofing Material S - Stucco X - Miscellaneous Debris		

Relinquished By: Steven Havens

Date/Time: 10-20-15

Received By: *P. Williams*

Relinquished By: _____

Date/Time: _____

Received By: _____

10/20/15 8:30am

9594 Newton Grove Court, Las Vegas, Nevada 89148

Infinity Inspector Steven Havens	Project Name EPA - QAL Building	Project Number 15-0531-01	Date Sampled 10-19-15
Infinity Contact Steven Havens	Project Location UNLV	Analysis Type Asbestos Bulk (PLM)	Instructions:
Infinity Phone Number (702) 449-1479	Infinity Email Lvhavens@gmail.com	Turn Around Time Same Day	
SAMPLE ID	MATERIAL DESCRIPTION	SAMPLE LOCATION	SAMPLE NOTES
QAL 21 - FT - 16	12" x 12" Black Floor Tile with Yellow Mastic	Room 21	The Gray and White Sheet Flooring was Located over the Floor Tile
QAL 21 - FT - 17	12" x 12" Black Floor Tile with Yellow Mastic	Room 21	
QAL 21 - FT - 18	12" x 12" Black Floor Tile with Yellow Mastic	Room 21	
QAL 4 - FT - 19	9" x 9" Gray and White Floor Tile with Black Mastic	Middle of the Floor in Room 4	
QAL 4 - FT - 20	9" x 9" Gray and White Floor Tile with Black Mastic	Middle of the Floor in Room 4	
QAL 4 - FT - 21	9" x 9" Gray and White Floor Tile with Black Mastic	Under the cabinet in Room 4	

MATERIAL	CONDITION	UNITS	ASBESTOS
PFI - Pipe Fitting Insulation PPI - Pipe Part Insulation PEI - Pipe Elbow Insulation PI - Pipe Insulation TSI - Thermal System Insulation FP - Fire Proofing BI - Boiler Insulation FT - Floor Tile FTM - Floor Tile Mastic SF - Sheet Flooring CB - Cove Base CBM - Cove Base Adhesive ACT - Acoustical Ceiling Tile ACS - Acoustical Ceiling Spray WT - Wall Texture WP - Wall Plaster DW - Drywall JC - Joint Compound RM - Roofing Material S - Stucco X - Miscellaneous Debris	G - Good (No maintenance is required currently) <10% D - Damaged (Some repair needed) SD - Significantly Damaged (Repair or replace ASAP)	LF - Linear Ft SF - Square Ft CF - Cubic Ft	A = Amosite CH = Chrysotile
Relinquished By: <u>Steven Havens</u> Relinquished By: _____ Date/Time: <u>10-20-15</u> Date/Time: _____ Received By: <u>[Signature]</u> Received By: _____ <u>10/20/15 8:30am</u>			



Bulk Asbestos Analysis

(EPA Method 600/R-93-116, Visual Area Estimation)

Infinity Environmental Services
Steve Havens
9594 Newton Grove Court

Las Vegas, NV 89148

Client ID: L1234
Report Number: B212088
Date Received: 10/20/15
Date Analyzed: 10/20/15
Date Printed: 10/20/15
First Reported: 10/20/15

Job ID/Site: 15-0531-01, EPA-QAL Building, UNLV**FALI Job ID:** L1234**Date(s) Collected:** 10/19/2015**Total Samples Submitted:** 21**Total Samples Analyzed:** 21

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
QAL 18-CT-01	01105523						
Layer: Burgundy with White Spots Ceramic			ND				
Layer: Black Mastic			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Comment: Middle of the Floor in Room 18							
QAL 18-CT-02	01105524						
Layer: Burgundy with White Spots Ceramic			ND				
Layer: Black Mastic			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Comment: Middle of the Floor in Room 18							
QAL 18-CT-03	01105525						
Layer: Burgundy with White Spots Ceramic			ND				
Layer: Black Mastic			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Comment: Middle of the Floor in Room 18							
QAL 18-CT-04	01105526						
Layer: Dark Brown Ceramic Tile			ND				
Layer: Black Mastic			ND				
Layer: Off-White Woven Material			ND				
Layer: Red-Brown Grout			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Comment: Under the Cabinet in Room 18							
QAL 18-CT-05	01105527						
Layer: Dark Brown Ceramic Tile			ND				
Layer: Black Mastic			ND				
Layer: Off-White Woven Material			ND				
Layer: Red-Brown Grout			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Comment: Under the Cabinet in Room 18							

Report Number: B212088

Client Name: Infinity Environmental Services

Date Printed: 10/20/15

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
QAL 18-CT-06	01105528						
Layer: Dark Brown Ceramic Tile			ND				
Layer: Black Mastic			ND				
Layer: Off-White Woven Material			ND				
Layer: Red-Brown Grout			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Under the Cabinet in Room 18							
QAL 18-TG-07	01105529						
Layer: Grey Grout			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Middle of the Floor in Room 18							
QAL 18-TG-08	01105530						
Layer: Grey Grout			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Middle of the Floor in Room 18							
QAL 18-TG-09	01105531						
Layer: Grey Grout			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Middle of the Floor in Room 18							
QAL 18-TC-10	01105532						
Layer: Tan Cementitious Material			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Under the Ceramic Tiles Middle of Room 18							
QAL 18-TC-11	01105533						
Layer: Tan Cementitious Material			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Under the Ceramic Tiles Middle of Room 18							
QAL 18-TC-12	01105534						
Layer: Tan Cementitious Material			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Under the Ceramic Tiles Middle of Room 18							

Client Name: Infinity Environmental Services

Report Number: B212088

Date Printed: 10/20/15

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
QAL 21-FT-13	01105535						
Layer: Grey/White Sheet Flooring			ND				
Layer: Fibrous Backing Non-Fibrous			ND				
Layer: Yellow Mastic			ND				
Layer: White Tile			ND				
Layer: Yellow Mastic			ND				
Layer: Off-White Non-Fibrous Material			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Room 21							
QAL 21-FT-14	01105536						
Layer: Grey/White Sheet Flooring			ND				
Layer: Fibrous Backing Non-Fibrous			ND				
Layer: Yellow Mastic			ND				
Layer: White Tile			ND				
Layer: Yellow Mastic			ND				
Layer: Off-White Non-Fibrous Material			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Room 21							
QAL 21-FT-15	01105537						
Layer: Grey/White Sheet Flooring			ND				
Layer: Fibrous Backing Non-Fibrous			ND				
Layer: Yellow Mastic			ND				
Layer: White Tile			ND				
Layer: Yellow Mastic			ND				
Layer: Off-White Non-Fibrous Material			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Room 21							
QAL 21-FT-16	01105538						
Layer: Black Tile			ND				
Layer: Yellow Mastic			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Room 21							
QAL 21-FT-17	01105539						
Layer: Black Tile			ND				
Layer: Yellow Mastic			ND				
Total Composite Values of Fibrous Components:	Asbestos (ND)						
Cellulose (Trace)							
Comment: Room 21							

Report Number: B212088

Date Printed: 10/27/15

Client Name: Infinity Environmental Services

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
QAL 21-FT-18	01105540						
Layer: Black Tile			ND				
Layer: Yellow Mastic			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Comment: Room 21							
QAL 4-FT-19	01105541						
Layer: Grey and White Tile		Chrysotile	2 %				
Layer: Black Mastic		Chrysotile	7 %				
Total Composite Values of Fibrous Components:		Asbestos (2%)					
Cellulose (Trace)							
Comment: Middle of the Floor in Room 4							
QAL 4-FT-20	01105542						
Layer: Grey and White Tile		Chrysotile	2 %				
Layer: Black Mastic		Chrysotile	7 %				
Total Composite Values of Fibrous Components:		Asbestos (2%)					
Cellulose (Trace)							
Comment: Middle of the Floor in Room 4							
QAL 4-FT-21	01105543						
Layer: Grey and White Tile		Chrysotile	2 %				
Layer: Black Mastic		Chrysotile	7 %				
Total Composite Values of Fibrous Components:		Asbestos (2%)					
Cellulose (Trace)							
Comment: Under the cabinet in Room 4							

Rachel Kolberg

Rachel Kolberg, Laboratory Analyst, Las Vegas Laboratory

Note: Limit of Quantification ('LOQ') = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

Analytical results and reports are generated by Forensic Analytical Laboratories Inc. (FALI) at the request of and for the exclusive use of the person or entity (client) named on such report. Results, reports or copies of same will not be released by FALI to any third party without prior written request from client. This report applies only to the sample(s) tested. Supporting laboratory documentation is available upon request. This report must not be reproduced except in full, unless approved by FALI. The client is solely responsible for the use and interpretation of test results and reports requested from FALI. Forensic Analytical Laboratories Inc. is not able to assess the degree of hazard resulting from materials analyzed. FALI reserves the right to dispose of all samples after a period of thirty (30) days, according to all state and federal guidelines, unless otherwise specified. All samples were received in acceptable condition unless otherwise noted.

STATE OF NEVADA
DEPARTMENT OF BUSINESS AND INDUSTRY
DIVISION OF INDUSTRIAL RELATIONS
Occupational Safety and Health Administration
Asbestos Control Program

Certifies That Steven Havens
Infinity Environmental Services LLC
is Licensed As Asbestos Abatement Consultant

License No. IM-472

Expiration Date 06/23/2016

Signature Of Licensee





UNIVERSITY of
NEVADA
LAS VEGAS

PLANNING & CONSTRUCTION
4606 MARYLAND PARKWAY
LAS VEGAS, NEVADA 89164
PHONE (702) 896-2600

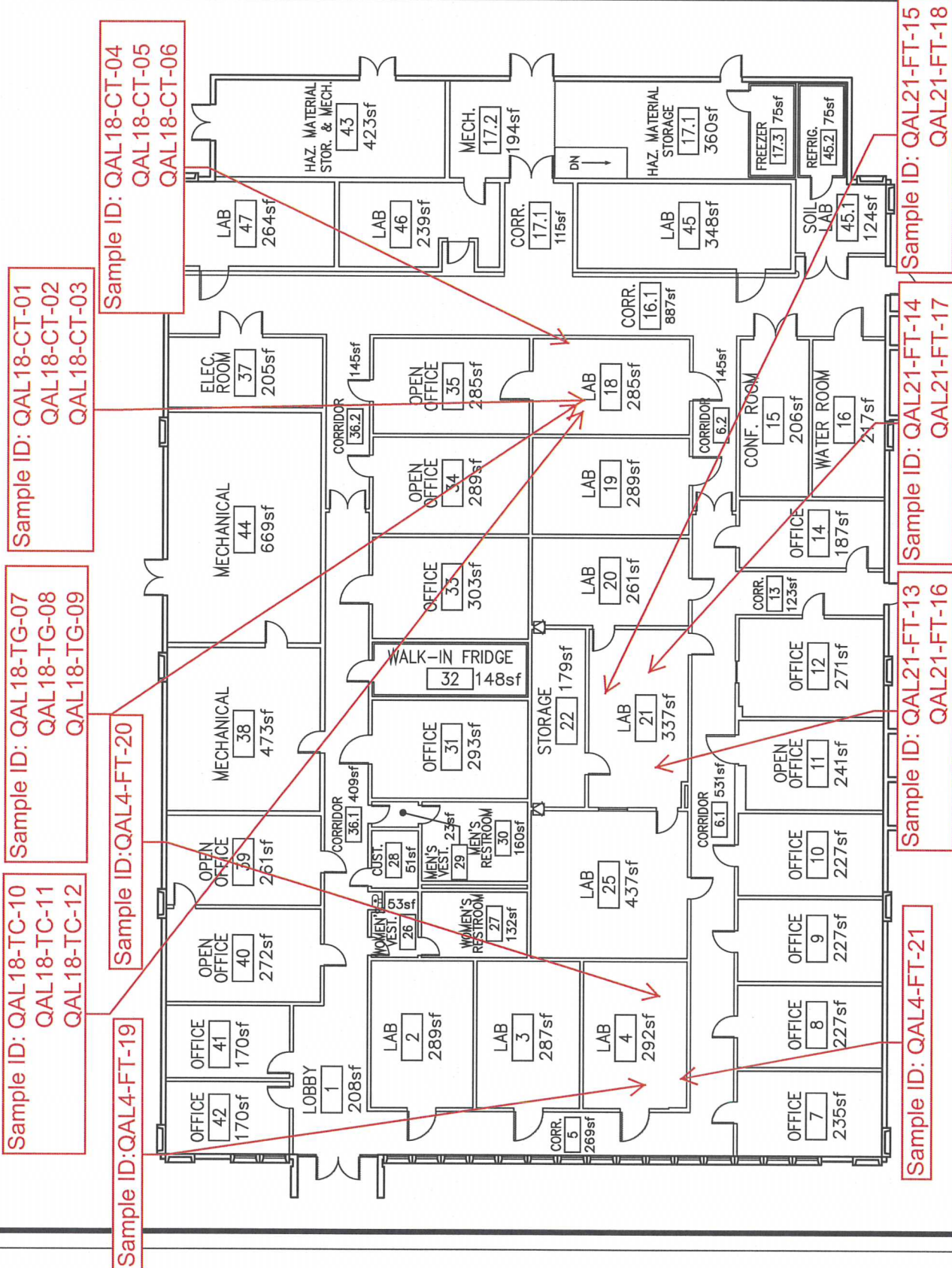
Date: 11/30/10

File: EPA=QAL-1.dwg

Not to Scale

EPA

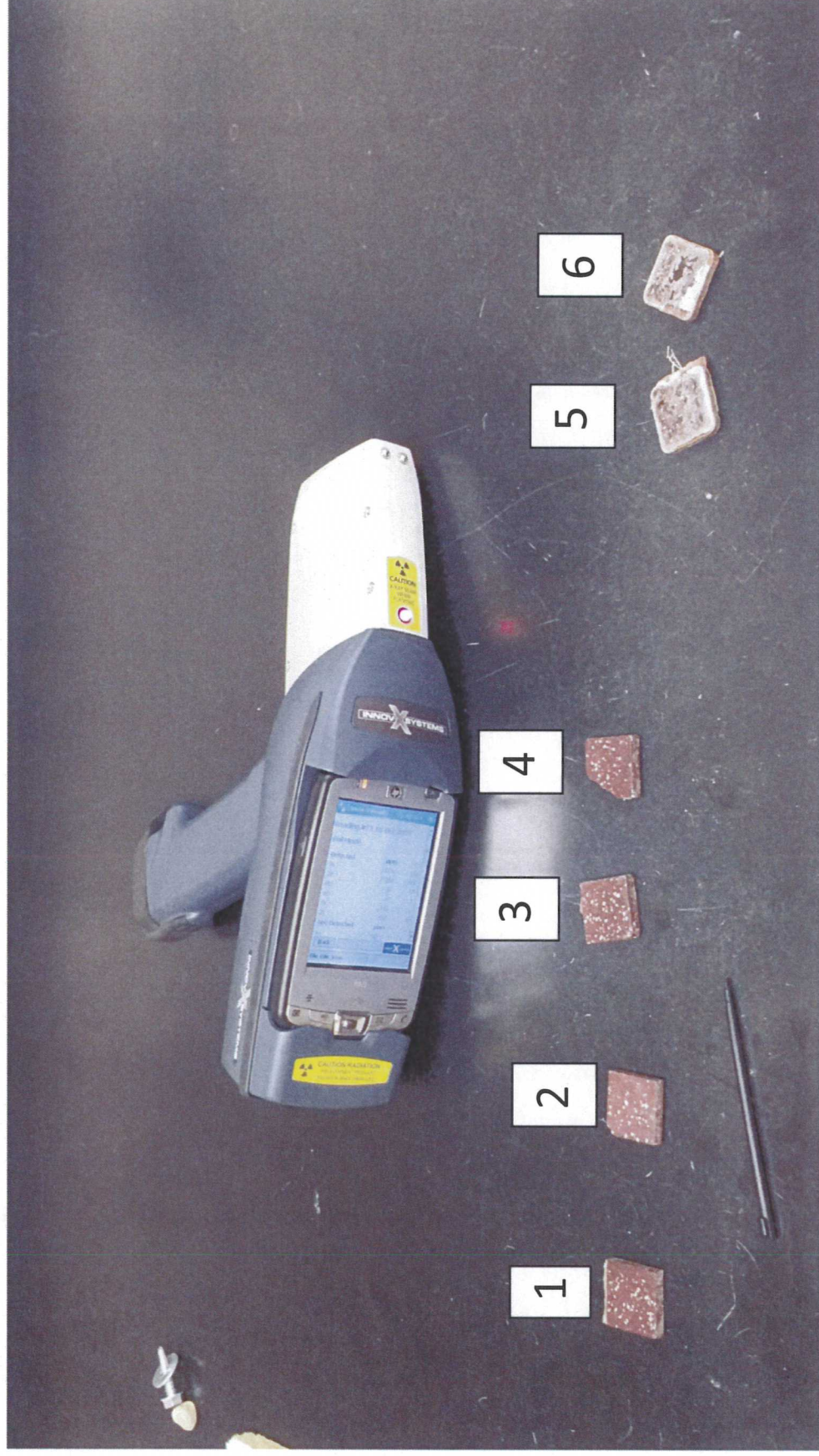
Environmental Protection
Agency - Quality
Assurance Laboratory (QAL)
First Floor Plan



Date	Reading	Mode	Pb	Pb +/-	
16-Oct-15	BAL 03 soil standard	Soil		76	9
16-Oct-15	Tile 1	Soil		66	18
16-Oct-15	Tile 2	Soil		63	17
16-Oct-15	Tile 3	Soil	<LOD		44
16-Oct-15	Tile 4	Soil		85	19
16-Oct-15	Tile 5	Soil		42	13
16-Oct-15	Tile 6	Soil		53	14
16-Oct-15	Tile 3 duplicate	Soil		57	17

Tiles 1 through 4 are medium red tiles covering the main floor, Tiles 5 and 6 are dark red tiles from under the counter

QAL-18 XRF Analysis of Tiles



Tiles 1 – 4 are from the exposed floor. Tiles 5 and 6 are from under the cabinetry near the sink.

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. References.
- B. Format.
- C. Schedules.
- D. Submittals.
- E. Updating schedules.

1.02 RELATED SECTIONS

- A. Section 01 11 00 - Summary of Work.
- B. Section 01 26 00 - Contract Modification Procedures.
- C. Section 01 29 00 - Payment Procedures.
- D. Section 01 33 00 - Submittal Procedures.

1.03 REFERENCES

- A. "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry", The Associated General Contractors of America (AGC), Washington, D.C., 1976 edition.

1.04 FORMAT

- A. Listings: Reading from left to right, in ascending order for each activity.
- B. Diagram Sheet Size: Maximum Size 30" x 42".
- C. Scale and Spacing: To allow for notations and revisions.

1.05 SCHEDULES

- A. Prepare progress schedules and supporting mathematical analyses using the Critical Path Method, under concepts and methods outlined in AGC's "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry".
- B. Diagrams to illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.
- C. Illustrate complete sequence of construction by activity, using a level of detail the same as, or greater than, the Schedule of Values. Provide dates for submittals, including those for Owner furnished items; dates for procurement and delivery of products, and dates for installation and provision for testing. Provide legend for symbols and abbreviations used.
- D. Coordinate contents with Schedule of Values.

- E. Schedule shall be resource loaded to include estimated manpower requirements for the duration of the activity.
- F. Allocate appropriate estimated time for asbestos and lead paint abatement, in a manner not affecting work renovation completion time.

1.06 SUBMITTALS

- A. Submit proposed preliminary schedules prior to the Pre-Construction meeting. Also submit abbreviated schedule short form.
- B. Participate in review of preliminary schedules jointly with Owner and Architect.
- C. Within fourteen (14) days of Notice to Proceed, submit schedule incorporating all comments from the joint review.
- D. Submit updated schedules with each Application for Payment.
- E. Submit three (3) copies.

1.07 UPDATING SCHEDULES

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update diagrams to graphically depict current status of Work.
- C. Identify activities modified since previous submittal, major changes in Work, changes associated with Change Orders, and any other identifiable changes.
- D. Indicate changes required to maintain Date of Substantial Completion.
- E. Provide narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken, or proposed, and its effect.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PHOTOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Photography.
- B. Camera.
- C. Prints.
- D. Technique.
- E. Submittals.

1.02 RELATED SECTIONS

- A. Section 01 29 00 - Payment Procedures.
- B. Section 01 33 00 - Submittal Procedures.
- C. Section 01 77 00 - Closeout Procedures

1.03 PHOTOGRAPHY

- A. Provide photographs of the site before any construction is started and throughout the progress of the Work. Photographs shall be of a quality acceptable to the Owner and Architect.
- B. Photographs should be taken within seven (7) days of each monthly Application for Payment and should represent work completed during the period preceding the Application for Payment. Photographs should be taken throughout the progress of the Work, up to and including Substantial Completion. Include as a minimum, the following:
 - 1. Site clearing.
 - 2. Excavations.
 - 3. Foundations.
 - 4. Structural framing.
 - 5. Enclosure of building.
 - 6. Interior views.
 - 7. Substantial completion.

1.04 CAMERA

- A. Digital.

1.05 PRINTS

- A. Color; one print of each view.
- B. Minimum size: 4 x 6 inches.

1.06 TECHNIQUE

- A. Provide factual presentation.
- B. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field,

and minimum distortion.

1.07 SUBMITTALS

- A. Deliver prints with each Application for Payment.
 - 1. Prints to be submitted in an 8-1/2" x 11" format.
 - 2. Each print to be identified with the project name, number, subject/phase of work, orientation of view, approximate time of view, date and the name of the person taking the photo.
- B. Pictures will be taken at approximately the same time of the month, each month.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures.
- B. Construction Progress Schedules.
- C. Schedule of Values.
- D. Manufacturer's Instructions.

1.02 RELATED REQUIREMENTS

- A. Section 01 25 13 - Product Substitution Procedures.
- B. Section 01 32 16 - Construction Progress Schedule.
- C. Section 01 32 33 - Photographic Documentation.
- D. Section 01 33 23 - Shop Drawings, Product Data, and Samples.
- E. Divisions 3 through 32.

1.03 PROCEDURES

- A. Deliver submittals to Architect at address listed in the Project Manual.
- B. Transmit each item with a separate submittal routing form.
- C. Identify project, contractor, subcontractor, major supplier.
- D. Identify pertinent drawing sheet and detail number.
- E. Specification section number, and individual product or other descriptive data as appropriate.
- F. Identify deviations from contract documents.
- G. Coordinate submittals of related items.

1.04 PROGRESS SCHEDULES

- A. Submit initial progress schedules in duplicate at the preconstruction meeting. After review by Architect/Owner, revise and resubmit within fourteen (14) days after receipt of the Notice to Proceed. Submit revised schedules with each Application for Payment, reflecting changes since previous submittal.

1.05 SCHEDULE OF VALUES

- A. Submit initial Schedule of Values, in duplicate, prior to the Pre-Construction Meeting. After review by the Architect/Owner, revise and resubmit within fourteen (14) days after receipt of Notice to Proceed.

1.06 SCHEDULE OF SUBMITTALS

- A. Submit initial Schedule of Submittals prior to the Pre-Construction Meeting. Schedule shall be in accordance with Section 01 33 23 - Shop Drawings, Product Data and Samples.

1.07 EXPANDED SUBCONTRACTORS AND MATERIAL SUPPLIES LISTING

- A. Submit expanded list of subcontractor's and material suppliers.

1.08 MANUFACTURER'S INSTRUCTIONS

- A. When required in individual Specification Section, submit manufacturer's printed instructions for delivery, storage, assembly, installation start-up, adjusting, and finishing, in quantities specified for product data, in Section 01 33 23.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop Drawings.
- B. Product data.
- C. Samples.
- D. Contractor review.
- E. Submittal requirements.
- F. Re-submittals.
- G. Architect review.
- H. Distribution.

1.02 RELATED SECTIONS

- A. Section 01 25 13 - Product Substitution Procedures.
- B. Section 01 33 00 - Submittal Procedures.
- C. Section 01 66 00 - Product Storage and Handling Requirements.
- D. Section 01 77 00 - Closeout Procedures.
- E. Divisions 3 through 32

1.03 SHOP DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with Project name and number; identify each element of drawings by reference to sheet number and detail, schedule, or room number of Contract Documents.
- B. Identify field dimensions; show relation to adjacent or critical features or work or products.
- C. Minimum Sheet Size: multiples of 8-1/2" x 11" inches.
- D. Maximum sheet size: 30 x 42 inches.
- E. Required Scale: Unless otherwise specifically directed by the Architect, make all shop drawings accurate to a scale sufficiently large to show all pertinent features of the item and its methods of connection to the Work.

1.04 PRODUCT DATA

- A. Submit only pages which are pertinent. Mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.

- B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information not applicable.

1.05 SAMPLES

- A. Submit to Architect full range of manufacturer's standard finishes except when more restrictive requirements are specified, indicating colors, textures, and patterns, for Architect selection. All color charts are to be originals (no photo reproduction copies).
- B. Submit samples to illustrate functional characteristics of products, including parts and attachments.
- C. Approved samples which may be used in the Work are indicated in the specification section.
- D. Label each sample with identification required for transmittal letter.
- E. Provide field samples of finishes and assemblies at the site, at location acceptable to the Architect, as required by individual specifications section. Install each sample or assembly complete and finished. Acceptable finishes in place may be retained in completed Work.
- F. Architect reviewed samples will set the standard by which all Work performed thereafter will be judged.
- G. Include electronic photo of all samples with submittal, in addition to the required physical samples.

1.06 CONTRACTOR REQUIREMENTS

- A. All submittals shall be made through the General Contractor or be rejected.
- B. Transmit submittals for shop drawings, product data and samples in accordance with the accepted Schedule of Submittals and in sequence to avoid delay in Work.
- C. Contractor shall not commence any portion of the Work, which requires a shop drawing or sample submission until the submission has been reviewed and returned by the Architect.
- D. Review submittals to determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.
- E. Contractor shall notify the Architect in of any deviations or changes from the requirements included in the Contract Documents. All deviations or changes must be clearly identified by clouding or highlighting and provide a written descript of the deviation or change.
- F. Contractor shall schedule submittals so that the Architect has fourteen (14) calendar days after receipt at Architects office to review each submittal
- G. Coordinate submittals with requirements of Work and of Contract Documents.
- H. Sign or initial each sheet of shop drawings and product data, and each sample label to certify compliance with requirements of Contract Documents using the Submittal Stamp (illustrated in paragraph 1.07 of this Section).
- I. Do not fabricate products or begin Work, which requires a submittal until submittal is returned with Architect's or Engineer's stamp of review.

- J. Make any corrections required by the Architect and resubmit the required number of corrected copies of shop drawings or new samples.
- K. Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than correction required by the Architect.
- L. Contractor shall not use or allow to be used the Contract Documents to be used or reproduced as submittals or any part thereof.

1.07 SUBMITTAL REQUIREMENTS

- A. Transmit submittals in accordance with Schedule of Submittals, and in such sequence to avoid delay in the Work.
- B. Contractor is solely responsible for coordinating the delivery and pick-up of submittals, including any necessary corrections and re-submittals, to assure that Architect's review can be obtained without delaying the Work.
- C. Number submittals consecutively.
- D. Each submittal shall allow for a 4 inch x 5 inch blank space for the Submittal Stamp.
- E. Contractor shall have prepared and will use the Submittal Stamp exactly as illustrated below.

By making this Submittal No. _____

(Contractor)

does hereby approve this submittal and certifies that it has determined and verified all materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within this submittal with the requirements of the Work and of the contract documents. Contractor further certifies that, to the best of its knowledge, the materials described for this Submittal does not contain any asbestos containing materials.

SIGNED FOR THE CONTRACTOR

DATE

- F. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes involving Architect's selection of colors, textures, or patterns.
 - 2. Associated items that require correlation for efficient function or for installation.
 - 3. Provide:
 - a. All submittals required by a particular section at one time.
 - b. Shop drawing, schedules, product data, coordination drawings, samples, color charts and other information required (whether listed or not) for Architects complete evaluation.
 - 4. Incomplete information or partial submittals shall be cause for rejection.
- G. Submit one (1) electronic copy of shop drawings unless otherwise requested.
- H. Submit number of samples specified in individual specification sections, but no less than five (5).

1.08 ARCHITECT REQUIREMENTS

- A. Review shop drawings, product data, and samples and return submittals to the General Contractor.
- B. Perform review of each submittal within twelve (12) working days after receipt. Provide written notice to the Contractor should more time be required for evaluation, coordination, and/or review.
- C. Extension of review time shall not constitute a basis to automatically extend the Contract Time.
- D. Notify the Contractor of any corrections required, include the number of corrected copies of shop drawings or new samples required.
- E. Architect shall reject any submittal not made through the General Contractor, and/or not stamped and signed by General Contractor.

1.09 RE-SUBMITTALS

- A. Re-submittals shall be identified by means of an alphabetical suffix (beginning with A) after original submittal number.
- B. Prepare re-submittals under procedures specified for initial submittals; identify changes made since previous submittal.
- C. Architect has fourteen (14) working days after receipt at Architects office to review each re-submittal.

1.10 DISTRIBUTION

- A. Duplicate and distribute reproductions of shop drawings, copies of product data, and samples, which bear Architect stamp of review, to job site file, record documents file, subcontractors, suppliers, and other entities requiring information.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 SCHEDULE OF SUBMITTALS

- A. Submit a Schedule of Submittals.
- B. Schedule of Submittals shall be prepared in detail, using one line for each item and sorted by specification section.
- C. Format shall clearly indicate the following:
 - 1. Specification section.
 - 2. Specification title.
 - 3. Proposed date scheduled to Architect.
 - 4. Lead times after approval.

- D. Format shall indicate if submittal is a shop drawing, product data or sample.
- E. Format shall indicate if submittal includes certificates or manufacturer's literature.
- F. Architect shall have acceptance of the proposed Schedule of Submittals.

END OF SECTION

SECTION 01 35 16

ALTERATION PROJECT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Products and installation for patching and extending Work
- B. Transition and adjustments
- C. Repair of damaged surfaces, finishes, and cleaning

1.02 RELATED SECTIONS

- A. Section 01 50 00 - Temporary Facilities and Controls.
- B. Section 01 73 29 - Cutting and Patching.
- C. Section 01 74 13 - Progress Cleaning.
- D. Section 01 74 23 - Final Cleaning.
- E. Section 02 41 00 - Selective Demolition.

PART 2 PRODUCTS

2.01 PRODUCTS FOR PATCHING AND EXTENDING WORK

- A. New Materials: as specified in product sections; match existing products and Work for patching and extending Work.
- B. Type and Quality of Existing Products: determine by inspection and testing products where necessary, referring to existing Work as a standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that hazardous materials, including asbestos and lead, will not be encountered. Notify the Owner before starting any demolition of unknown and additional discovered locations, and as soon as such suspected materials are encountered.
- B. Verify that demolition is complete, and areas are ready for installation of new Work.
- C. Beginning of restoration Work means acceptance of existing conditions.

3.02 PREPARATION

- A. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
- B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

- C. Remove debris and abandoned items from area and from concealed spaces.
- D. Prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.
- E. Close openings in exterior surfaces to protect existing Work and salvage items from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

3.03 INSTALLATION

- A. Coordinate Work of alternations and renovations to expedite completion and to accommodate Owner occupancy.
- B. Remove, cut, and patch Work in a manner to minimize damage and to provide a means of restoring products and finishes to original and specified condition.
- C. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.
- D. In addition to specified replacement of equipment and fixtures restore existing plumbing, heating, ventilation, air conditioning, and electrical systems to full operational condition.
- E. Install products as specified in individual sections.

3.04 TRANSITIONS

- A. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patched work to match existing adjacent Work in texture and appearance.
- B. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Owner/ Architect.

3.05 ADJUSTMENTS

- A. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- B. Where a change of plane of 1/4 inch or more occurs, submit recommendation for providing a smooth transition for Owner/ Architect review and request instructions from Owner/ Architect.
- C. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.
- D. Fit Work at penetrations of surfaces as specified in Section 01 73 29.

3.06 REPAIR OF DAMAGED SURFACES

- A. Patch or replace portions of existing surfaces, which are damaged, lifted, discolored, or showing other imperfections.
- B. Repair substrate prior to patching finish.

3.07 FINISHES

- A. Finish surfaces as specified in individual product sections.

- B. Finish patches to product uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.08 CLEANING

- A. As specified in Sections 01 74 13 and 01 74 23.

END OF SECTION

SAFETY AND ENVIRONMENTAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Laws, Ordinances and Regulations.
- C. Safety and Health.
- D. Safety Representative.
- E. Safety Training.
- F. Emergency Procedures.
- G. Dust Abatement.
- H. Storm Water Permits.

1.02 SUBMITTALS

- A. The Contractor shall submit, within fifteen (15) days following Notice to Proceed, a work-site-specific safety program that includes the following:
 - 1. A site-specific Injury and Illness Prevention Program (IIPP) covering all work and Contractor and subcontractor employees at the site.
 - 2. The name of the Contractor's on-site safety representative.
 - 3. A written Emergency Action and Fire Protection Plan covering all work and Contractor and subcontractor employees at the site.
- B. In addition to the reports that the Contractor is required to file under the provisions of Nevada State Industrial Insurance System, the Contractor shall file a report with the Owner on or before the 10th calendar day of each month giving:
 - 1. The total force employed on the Contract in work days during the previous calendar month.
 - 2. The number and character of all accidents resulting in loss of time, medical treatment and first aid treatment.
 - 3. Any other information or classification of employee injuries received on the work and disabilities resulting there from that may be required by the Owner.

1.03 LAWS, ORDINANCES, AND REGULATIONS

- A. The Contractor shall comply with the Construction Safety Orders and other applicable safety orders described within the Regulations for the Nevada Occupational Safety and Health Enforcement Program and the Nevada Occupational Safety and Health Act, and such other rules, regulations, and laws applicable during the progress of the work.
- B. The Contractor shall have copies of the following at the work site. The required information shall be made available to the Owner for review upon request:
 - 1. A copy of the Nevada Occupational Safety and Health Act, and Regulations for the Nevada Occupational Safety and Health Enforcement Program.
 - 2. Material Safety Data Sheets for all chemicals or potentially hazardous materials being used or stored at the site.
 - 3. Permits as required for the work.

- A. The Contractor shall have and implement a written site-specific IIPP and Code of Safe Work Practices covering site work to be performed under the Contract. The IIPP shall be in compliance with the specific requirements of the Nevada Occupational Safety and Health Act and Regulations for the Nevada Occupational Safety and Health Enforcement Program.
- B. All persons shall be required to wear hard hats and suitable hard soled work shoes in good repair (safety style steel or fiberglass toe shoes are recommended) while at the work site. Sandals, athletic shoes, and other soft footwear may not be worn on the work site.
- C. The Contractor's Emergency Action and Fire Protection Plan shall be in compliance with the specific requirements of 29 CFR Part 1926, § 1926.35.
- D. The Contractor shall publish an alcohol and drug-free work site policy statement notifying all employees that the unlawful manufacture, distribution, dispensing, possession, or use of alcohol or a controlled substance is prohibited at the work site and specifying the actions that will be taken against employees for violation of such prohibition. Additionally, the Contractor shall publish a "no smoking on the construction site" policy statement notifying all employees that smoking will not be allowed on the construction site.
 - 1. The Contractor shall report to the Owner any violations of the substance abuse program and the disposition of the violation within 24 hours of Contractor becoming aware of the violation.
- E. The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work.
- F. The Contractor shall continually monitor and audit its compliance and adherence with its safety program.
- G. The Contractor shall make every effort to ensure the safety of all inspectors and other employees, consultants, and Owner's personnel. The Contractor shall not permit inspectors, employees, consultants, and agents to enter any unsafe place for the purpose of making inspections, except where an inspection is required to determine if previously detected unsafe conditions have been corrected. Where work is required to be inspected by the Owner and the inspection is not performed due to the existence of an unsafe condition, such work is subject to rejection, or the work may be suspended in accordance with Document AIA A201, Conditions of the contract.
- H. When sufficient time is available, the Contractor shall notify the Owner in advance of safety inspections by Nevada or Federal/OSHA, the fire department, or other governmental agencies. The Owner may attend safety inspections when notice is given sufficiently in advance for the Owner to be present. When the Owner is not present during a safety inspection, the Contractor shall immediately report to the Owner that an inspection has taken place, and describe any violations, or citations, and the Contractor's abatement actions or salient events arising from the inspection.
- I. Whenever deficiencies are noted that have not previously been addressed by the Contractor, the Owner will give the Contractor written notice to correct the deficiency. Noted deficiencies shall be corrected immediately upon observation or notification. Where deficiencies cannot be corrected immediately, the Contractor shall develop a corrective action plan outlining the steps to be taken and when each step will be completed. The next working day following the Contractor's receipt of the notice, the Contractor shall provide the Owner with a written statement either describing the corrective action taken or corrective action plan developed.

1.05 CONTRACTOR'S SAFETY REPRESENTATIVE

- A. The Contractor's designated safety representative shall be on-site when any work is in progress.
- B. The Contractor's safety representative shall have the authority to correct unsafe conditions and unsafe practices, and shall be responsible for directing the required safety programs. The safety representative shall have the authority to suspend work until safe conditions or practices are corrected.
- C. The Contractor's safety representative shall be charged with the responsibility of daily on-site safety coordination and inspections and shall record the results of the inspections on a weekly report. The weekly report shall be submitted to the Owner not later than the first working day following the work week covered by the report.

1.06 SAFETY TRAINING

- A. The Contractor shall conduct a meeting with its employees and subcontractor employees on general safe work practices or on a topic from the Contractor's Code of Safe Work Practices weekly. The meetings shall be scheduled on the same day of the week and at a fixed time. A record of the session including who was in attendance and subjects discussed shall be prepared and made available for review by the Owner.

1.07 EMERGENCY PROCEDURES

- A. The Contractor shall designate responsible personnel to make emergency calls. Should an emergency occur, the Contractor shall:
 - 1. Immediately secure the area and implement the Contractor's emergency action plan.
 - 2. Notify the Owner or his representative.
 - 3. Provide information regarding the emergency to the appropriate authorities and authorized Owner representatives only. Questions from others including the press and media shall be referred to the Owner.
- B. Emergency procedures shall ensure that the Contractor's most senior supervisor present takes charge and directs the handling of the emergency.
- C. The Contractor shall immediately notify the Owner of the existence of hazardous conditions. However, it shall be the Contractor's responsibility to take necessary precautions against injury to persons or damage to property from such hazardous conditions until corrected by the responsible party.

1.08 DUST ABATEMENT

- A. The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent its operations from causing visible dust emissions from leaving the work areas. These measures shall include, but are not limited to, providing additional watering equipment, reducing vehicle speed on haul roads, restricting traffic on haul roads, and covering haul vehicles. The Contractor shall be responsible for any damage resulting from any dust originating from operations. The dust abatement measures shall be continued for the duration of the contract.
- B. The Contractor shall hose down any vehicle or equipment leaving the project area with water prior to entering the public right of way if the vehicles appear to be transporting excessive amounts of dust. When any material or debris is tracked out from the project area, the Contractor shall clean all paved public roads near the site entrances as often as required to prevent spreading of dust by vehicles.
- C. The contractor shall furnish the dust control permit.

1.09

STORM WATER PERMITS

- A. The Contractor (permit tee) shall obtain the storm water permit required by Federal Law under the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 et seq; the "Act") for construction activities that disturb one (1) or more acres. Federal law prohibits discharges of pollutants in storm water from construction activities without a National Pollutant Discharge Elimination System (NPDES) Permit; Operator(s) of construction sites where one (1) or more acres are disturbed must submit a Notice of Intent (NOI) to obtain coverage under an NPDES Storm Water Construction General Permit. Any questions should be directed to the Nevada Division of Environmental Protection (NDEP) Bureau of Water Pollution Control, 333 West Nye Lane, Carson City, Nevada 89710, telephone 775-687-4670.
- B. All violations and fines will be the responsibility of the Contractor should the Contractor fail to obtain and/or comply with the regulations of the NDEP Storm Water Pollution Prevention Permit.
- C. Follow the instructions included in the Storm Water Pollution Prevention Permit (SWPPP) Package available from the NDEP, which can be obtained at the address noted above or on the Storm Water Website at: <http://ndep.state.nv.us/bwpc/storm01/htm>. In addition the website contains electronic forms for the Notice of Intent and Notice of Termination (NOT) and other valuable information.
 - 1. Submit a NOI to the NDEP, two (2) days prior to the start of construction.
 - 2. Upon submission to the NDEP provide one copy each of the NOI and the Storm Water Pollution Prevention Plan (SWPPP) to the Architect.
 - 3. An authorization letter will be sent by the NDEP to the Contractor (general permit holder) stating the authorization date. Contractor shall comply with any special conditions as required by the NDEP. Upon receipt of the Authorization Letter, forward one copy each to the Architect.
 - 4. By signing the NOI the Contractor certifies that the Contractor's SWPPP has been completed, and that the SWPPP will be stored and maintained at the Construction site.
 - 5. Continuation of coverage: If project has not reached completion prior to June 30, (Fiscal Year - July 1) a new NOI must be submitted to NDEP. Permit tee must include the previously supplied permit I.D. number (3xxxx) with the submittal of the new NOI. All permits must be renewed annually until project is completed. Contractor must submit a new Notice of Intent **thirty days** prior to the renewal date (Fiscal Year - July 1).
- D. Upon completion of the project (final stabilization) the Contractor must submit an NOT to the NDEP.
 - 1. Provide a copy of NOT to the Architect.
- E. Implement the approved plan.
 - 1. Include line item in the Schedule of Values indication full value of SPPP practices.
 - 2. Certification of monthly payment for this work is contingent upon successful maintenance of SPPP mitigation practices.

PART 2

PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 40 00

QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality assurance and control of installation
- B. References
- C. Inspection and testing laboratory/agency services

1.02 RELATED SECTIONS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 01 43 26 - Testing and Inspecting Agency.
- C. Section 01 66 00 - Product Storage and Handling Requirements.
- D. Section 01 75 10 - Demonstration and Training.

1.03 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from the Architect before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce workmanship of specified quality.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.04 REFERENCES

- A. Conform to reference standard by date of issue current on date of Contract Documents.
- B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.05 INSPECTION AND TESTING LABORATORY/AGENCY SERVICES

- A. Owner will appoint, employ, and pay for services of an independent firm to perform inspection and testing, unless noted otherwise.

- B. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by the Architect and Owner.
- C. Reports will be submitted by the independent firm to the Owner with copies to the Architect, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, copies of equipment and product submittals, performance data, and assistance as requested.
 - 1. Contractor will notify the Architect and independent firm a minimum of 48 hours prior to expected time for operations requiring services. Contractor to cooperate with the inspector.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- E. Retesting performed by the independent agency required because of non-conformance to specified requirements or because of lack of preparation preventing testing will be back-charged to the Contractor. Payment due the Owner because of failed testing shall be attained by deducting the testing charges from the Contract Sum.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality assurance.
- B. Schedule of references.
- C. Statutory requirements for Construction Contract and subcontracts.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents unless a date is specified in a product section.
- C. Should specified reference standards conflict with Contract Documents, request clarification from Owner before proceeding.
- D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.03 SCHEDULE OF REFERENCES

AA	Aluminum Association 818 Connecticut Avenue, N.W.; Washington, D.C. 20006
AABC	Associated Air Balance Council 1518 K Street N.W.; Washington, D.C. 20005
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W.; Washington, D.C. 20001
ACI	American Concrete Institute Box 19150, Redford Station, Detroit, MI 48219
ADA	American Disability Act 1331 F Street, N.W., Washington, D.C. 20004-1111
ADC	Air Diffusion Council 230 North Michigan Avenue; Chicago, IL 60601
AFBMA	Anti Friction Bearing Manufacturing Association 1101 Connecticut Avenue, NW #700, Washington, D.C. 20036
AGC	Associated General Contractors of America 1957 E Street, N.W.; Washington, D.C. 20006
AI	Asphalt Institute Asphalt Institute Building, College Park, Maryland 20740

AIA	American Institute of Architects 1735 New York Avenue, N.W.; Washington, D.C. 20006
AISC	American Institute of Steel Construction 400 North Michigan Avenue, Eighth Floor Chicago, IL 60611
AISI	American Iron and Steel Institute 1000 16th Street, N.W.; Washington, D.C. 20036
AITC	American Institute of Timber Construction 333 W. Hampden Avenue, Englewood, CO 80110
AMCA	Air Movement and Control Association 30 West University Drive, Arlington Heights, IL 60004
ANSI	American National Standards Institute 1430 Broadway, New York, NY 10018
APA	American Plywood Association Box 11700, Tacoma, WA 98411
ARI	Air-Conditioning and Refrigeration Institute 1501 Wilson Boulevard, Arlington, VA 22209
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers 1791 Tullie Circle, N.E.; Atlanta, GA 30329
ASME	American Society of Mechanical Engineers 345 East 47th Street, New York, NY 10017
ASPA	American Sod Producers Association 4415 West Harrison Street, Hillside, IL 60162
ASTM	American Society for Testing and Materials 1916 Race Street, Philadelphia, PA 19103
AWI	Architectural Woodwork Institute 2310 South Walter Reed Drive, Arlington, VA 22206
AWPA	American Wood-Preservers' Association 7735 Old Georgetown Road, Bethesda, Maryland 20014
AWS	American Welding Society 550 LeJeune Road, N.W.; Miami, FL 33135
AWWA	American Water Works Association 6666 West Quincy Avenue, Denver, CO 80235
BIA	Brick Institute of America 11490 Commerce Park Drive, Reston, VA 22091
CDA	Copper Development Association 57th Floor, Chrysler Building, 405 Lexington Avenue New York, NY 10174
CLFMI	Chain Link Fence Manufacturers Institute

CRSI	Concrete Reinforcing Steel Institute 933 Plum Grove Road, Schaumburg, IL 60195
DHI	Door and Hardware Institute 7711 Old Springhouse Road, McLean, VA 22102
EJCDC	Engineers' Joint Contract Documents Committee American Consulting Engineers Council 1015 15th Street, N.W.; Washington, D.C. 20005
EJMA	Expansion Joint Manufacturers Association 25 North Broadway, Tarrytown, NY 10591
FGMA	Flat Glass Marketing Association 3310 Harrison, White Lakes Professional Building Topeka, KS 66611
FM	Factory Mutual System 1151 Boston-Providence Turnpike P.O. Box 688, Norwood, MA 02062
FS	Federal Specification General Services Administration Specifications and Consumer Information, Distribution Section (WFSIS); Washington Navy Yard, Bldg. 197, Washington, D.C. 20407
GA	Gypsum Association 1603 Orrington Avenue, Evanston, IL 60201
IAPMO	International Association of Plumbing and Mechanical Officials 20001 Walnut Drive South, Walnut, CA 91789
ICBO	International Conference of Building Officials, 5360 S. Workman Mill Road, Whittier, CA 90601
IEEE	Institute of Electrical and Electronics Engineers 345 East 47th Street, New York, NY 10017
IMIAC	International Masonry Industry All-Weather Council - International Masonry Institute 815 15th Street, N.W.; Washington, D.C. 20005
MBMA	Metal Building Manufacturer's Association 1230 Keith Building, Cleveland, OH 44115
MFMA	Maple Flooring Manufacturers Association 60 Rivere Drive, Northbrook, IL 60062
MIL	Military Specification Naval Publications and Forms Center 5801 Tabor Avenue, Philadelphia, PA 19120
ML/SFA	Metal Lath/Steel Framing Association 221 North LaSalle Street, Chicago, IL 60601
NAAMM	National Association of Architectural Metal Manufacturers 221 North LaSalle Street, Chicago, IL 60601

NCMA	National Concrete Masonry Association P.O. Box 781, Herndon, VA 22070
NEBB	National Environmental Balancing Bureau 8224 Old Courthouse Road, Vienna, VA 22180
NEMA	National Electrical Manufacturer's Association 2101 _L_ Street, N.W.; Washington, D.C. 20037
NETA	International Electrical Testing Association Electrical Acceptance Testing Specifications P. O. Box 687, Morrison, CO 80465
NFPA	National Fire Protection Association Battery March Park, Quincy, MA 02269
NFPA	National Forest Products Association 1619 Massachusetts Avenue, N.W.; Washington, D.C. 20036
NSWMA	National Solid Wastes Management Association 1730 Rhode Island Ave., N.W.; Washington, D.C. 20036
NTMA	National Terrazzo and Mosaic Association 3166 Des Plaines Avenue, Des Plaines, IL 60018
NWMA	National Woodwork Manufacturers Association 205 W. Touhy Avenue, Park Ridge, IL 60068
PCA	Portland Cement Association 5420 Old Orchard Road, Skokie, IL 60077
PCI	Prestressed Concrete Institute 201 North Wells Street, Chicago, IL 60606
PS	Product Standard U. S. Department of Commerce Washington, D.C. 20203
RIS	Redwood Inspection Service One Lombard Street, San Francisco, CA 94111
RCSHSB	Red Cedar Shingle and Handsplit Shake Bureau 515 116th Avenue, Bellevue, WA 98004
SDI	Steel Deck Institute P.O. Box 9506, Canton, OH 44711
SDI	Steel Door Institute 712 Lakewood Center North 14600 Detroit Avenue, Cleveland, OH 44107
SIGMA	Sealed Insulating Glass Manufacturers Association 111 East Wacker Drive, Chicago, IL 60601
SJI	Steel Joist Institute 1205 48th Avenue North, Suite A Myrtle Beach, SC 29577
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 8224 Old Court House Road, Vienna, VA 22180

SSPC	Steel Structures Painting Council 4400 Fifth Avenue, Pittsburgh, PA 15213
TCA	Tile Council of America, Inc. Box 326, Princeton, NJ 08540
UL	Underwriters' Laboratories, Inc. 333 Pfingston Road, Northbrook, IL 60062
WCLIB	West Coast Lumber Inspection Bureau 6980 S.W. Varns Road, Box 23145 Portland, OR 97223
WWPA	Western Wood Products Association 1500 Yeon Building, Portland, OR 97204
WIC	Woodwork Institute of California P.O. Box 698, Desert Hot Springs, CA 92240

1.04 STATUTORY REQUIREMENTS FOR CONSTRUCTION CONTRACTS AND SUBCONTRACTS

Each contractor or subcontractor shall comply with laws and all applicable standards, orders, or regulations issued pursuant thereto: including, but not limited to the following:

- A. The Copeland Anti-Kickback Act, as amended (18 USC 874) as supplemented in Department of Labor regulations (41 CFR Chapter 60).
- B. Nondiscrimination, Title VI of the Civil Rights Act of 1964 (P.L. 88-352), as amended, (42 USC 2000d) and the requirements imposed by the regulations of the Department of Commerce (15 CFR Part 8) issued pursuant to that title.
- C. The Flood Disaster Protection Act of 1973 (P.L. 93-234), as amended in 42 USC 4601.
- D. Architectural Barriers Act (P.L. 90-480), 42 USC 4151, as amended.
- E. Rehabilitation Act of 1973, 29 USC 794, Executive Order 11914, 12250.
Delete upon confirmation that Rehabilitation Act has been revoked.
- F. The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646, as amended in 42USC 4601), 15 CRF Part 916.
- G. The National Environmental Policy Act of 1969 (P.L. 91-190); the National Historic Preservation Act of 1966 (80 Stat 915, 16 USC 470); and Executive Order No. 11593 of May 31, 1971.
- H. Equal Employment Opportunity, Executive Order 11246, as amended by Executive Order 11478, and as supplemented in Department of Labor regulations (41 CFR Chapter 60).
- I. Certification of Nonsegregated Facilities as Required by the May 9, 1967, Order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor.
- J. The Clean Air Act, as amended, 42 USC 1857 et seq., the Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq. and the regulations of the Environmental Protection Agency with respect thereto, at 40 CFR Part 15, as amended from time to time.

- K. The Power Plant and Industrial Fuel Use Act of 1978 (92 Stat. 3318. P.L. 95-620) relating to the conservation of petroleum and natural gas.
- L. Americans with Disabilities Act (P.L. 101-336, 28 CFR, Part 36).

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

TESTING AND INSPECTING AGENCY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selection and payment.
- B. Laboratory and testing agency reports.
- C. Limits on testing laboratory/agency authority.
- D. Contractor responsibilities.
- E. Schedule of inspections and tests.

1.02 RELATED SECTIONS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 01 40 00 - Quality Control.
- C. Section 01 75 00 - Starting and Adjusting.
- D. Section 01 75 10 - Demonstration and Training.
- E. Section 01 77 00 - Closeout Procedures.
- F. Division 3 – Concrete.
- G. Division 22 - Plumbing.
- H. Division 23 – Heating, Ventilating, and Air Conditioning.
- I. Individual Specification Sections: Inspections and tests required, and standards for testing.

1.03 REFERENCES

- A. ANSI/ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. ANSI/ASTM E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
- C. AABC - Associated Air Balance Council, National Standards for Total Balance, 1982 Rev. 4: Criteria for AABC Certified Independent Agencies in their testing, adjusting and balancing of building environmental systems.
- D. AABC - National Project Certification Performance Guarantee: The requirement of a guarantee issued and backed by a national organization on the performance of the certified independent testing agency.
- E. NEBB - National Environmental Balancing Bureau, Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Fourth Edition, 1983: Criteria for certified NEBB Contractors in their testing, adjusting and balancing of building environmental systems.

1.04 SELECTION AND PAYMENT

- A. Owner shall employ and pay for services of an independent testing laboratory/agency to perform specified inspection and testing, unless otherwise noted.

1.05 LABORATORY/AGENCY REPORTS

- A. After each inspection and test, the laboratory will submit a copy of the laboratory/agency report to the Contractor, Owner, and the Architect.
- B. Include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector or certified testing engineer.
 - 4. Date and time of sampling or inspection,
 - 5. Identification of product and specifications section.
 - 6. Location in the Project.
 - 7. Type of inspection or test.
 - 8. Date of test.
 - 9. Results of tests.
 - 10. Conformance with Contract Documents.
- C. When requested by the Architect or Owner, the laboratory/agency will provide interpretation of test results.

1.06 LIMITS ON TESTING LABORATORY/AGENCY AUTHORITY

- A. Laboratory/agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory/agency may not approve or accept any portion of the Work.
- C. Laboratory/agency may not assume any duties of Contractor.
- D. Laboratory/agency has no authority to stop the Work.

1.07 CONTRACTOR RESPONSIBILITIES

- A. Deliver to laboratory/agency at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs. Deliver to the independent testing laboratory/agency copies of submittals.
- B. Cooperate with laboratory/agency personnel, and provide access to the Work.
- C. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, storage and curing of test samples.
- D. Contractor to notify the Architect, 48 hours prior to expected time for operations requiring inspection and testing services.
- E. Maintain organized records of all testing agency reports at the project site.

1.08 SCHEDULE OF INSPECTIONS AND TESTS

- A. Inspection and testing requirements are as specified in individual specification sections.

PART 2 PRODUCTS

Not Used

PART 3

EXECUTION

Not Used

END OF SECTION

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Products.
- B. Transportation and Handling.
- C. Storage and Protection.

1.02 RELATED SECTIONS

- A. Section 01 77 00 - Closeout Procedures.
- B. Individual Specification Sections - Requirements for materials and equipment.

1.03 PRODUCTS

- A. Products include material, equipment, and systems.
- B. Comply with Specifications and referenced standards as minimum requirements.
- C. Components required to be supplied in quantity within a specification section shall be of one manufacturer for the same product.

1.04 TRANSPORTATION AND HANDLING

- A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging.
- B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.
- C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

1.05 STORAGE AND PROTECTION

- A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.
- B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
- C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.
- D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching of Work
- B. NOTE: Nothing in this section is meant to override specific asbestos abatement control procedures and/or Section 02 41 13 – Selective Demolition.

1.02 RELATED SECTIONS

- A. Section 02 41 00 - Selective Demolition.
- B. Individual Specifications Sections:
 - 1. Cutting and patching incidental to Work of the section
 - 2. Advance notification to other sections of openings required in Work of those sections
 - 3. Limitations on cutting structural members

1.03 SUBMITTALS

- A. Submit written request to the Owner for approval prior to proceeding in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather-exposed or moisture-resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight-exposed elements.
- B. Include in request:
 - 1. Identification of Project.
 - 2. Location and description of affected Work.
 - 3. Necessity for cutting or alteration.
 - 4. Description of proposed Work, and products to be used.
 - 5. Alternatives to cutting and patching.
 - 6. Effect on Work of Owner or separate contractor.
 - 7. Date and time Work will be executed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Those required for original installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- B. After uncovering, inspect conditions affecting performance of Work.

- C. By starting cutting or patching operations, the Contractor acknowledges acceptance of existing conditions and the responsibility to restore cut and patched area to its original condition.
- D. Verify that hazardous materials, including asbestos, will not be encountered. Notify the Owner before starting any demolition, and as soon as such suspected materials are encountered.

3.02 PREPARATION

- A. Provide supports to assure structural integrity of surroundings, devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas, which may be exposed by uncovering Work.
- C. Maintain excavations free of water.

3.03 CUTTING AND PATCHING

- A. Execute cutting, fitting, and patching to complete Work, and to fit the several parts together to integrate with other Work.
- B. Uncover Work to install ill-timed Work.
- C. Remove and replace defective and non-conforming Work.
- D. Remove samples of installed Work for testing.
- E. Provide openings in elements of Work for penetrations of mechanical and electrical work.

3.04 PERFORMANCE

- A. Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- B. Employ experienced installers to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- C. Cut rigid materials using masonry saw or core drill. Pneumatic tools are not allowed without prior approval.
- D. Restore Work with new products in accordance with requirements of Contract Documents.
- E. Fit Work airtight and watertight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- F. At penetrations of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-resistant material, full thickness of the construction element.
- G. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

END OF SECTION

SECTION 01 74 13
PROGRESS CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning and disposal of waste materials, debris, and rubbish during construction.

1.02 RELATED SECTIONS

- A. Section 01 74 19 - Construction Waste Management.
- B. Section 01 74 23 - Final Cleaning.
- C. Individual Specification Sections: Specific cleaning for product or Work.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Provide covered containers for deposit of waste materials, debris, and rubbish.

PART 3 EXECUTION

3.01 CLEANING

- A. Maintain areas under Contractor's control free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Site to be broom swept once a week minimum. Shared areas of work with owner and building users shall be clean daily.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to closing the space.
- C. Daily clean interior areas to provide suitable conditions for Work.
- D. Broom clean interior areas prior to start of surface finishing, and continue cleaning on an as-needed basis.
- E. Control cleaning operations so that dust and other particles will not adhere to wet or newly-coated surfaces.

3.02 DISPOSAL

- A. Remove waste materials, debris, and rubbish from site at least weekly and dispose of off-site in a legal manner.
- B. Salvage, recycle and dispose waste materials under provisions of Section 01 74 19.

END OF SECTION

CONSTRUCTION WASTE MANAGEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Administrative and procedural requirements for the following:
 - 1. Salvaging non-hazardous demolition and construction waste.
 - 2. Recycling non-hazardous demolition and construction waste.
 - 3. Disposing of non-hazardous demolition and construction waste.

1.02 RELATED SECTIONS

- A. Section 02 41 00 - Selective Demolition.
- B. Section 02 41 15 – Landscape Demolition.

1.03 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, paint, or the like.
- B. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- C. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- D. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- E. Diversion: Avoidance of demolition and construction waste sent to landfill or incineration. Diversion does not include using materials for landfill, alternate daily cover on landfills, or materials used as fuel in waste-to-energy processes.
- F. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitability, corrosiveness, toxicity or reactivity.
- G. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- H. Recycling: The process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Salvage: Recovery of demolition or construction waste and subsequent reuse or sale in another facility.
- J. Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.
- K. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

- L. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- M. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- N. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 PERFORMANCE REQUIREMENTS

- A. The Owner has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.
- B. Of the waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal in landfills or incinerators shall be minimized, thereby reducing disposal costs.
- C. Develop a construction waste management plan that results in end-of-Project rates for salvage/recycling of 30% (by weight) of construction and demolition waste. Indicate on Site Plan location of demolition and construction waste and recycling receptacles for Owner's approval prior to placement.
- D. Salvage/Recycle Requirements: Salvage and recycle as much non-hazardous demolition and construction waste as possible, including the following materials:
 - 1. Demolition Waste:
 - a. Asphaltic concrete paving
 - b. Concrete
 - c. Concrete reinforcing steel
 - d. Concrete masonry units
 - e. Wood studs
 - f. Plywood and oriented strand board
 - g. Wood paneling
 - h. Wood trim
 - i. Structural and miscellaneous steel
 - j. Rough hardware
 - k. Insulation
 - l. Doors and frames
 - m. Door hardware
 - n. Windows
 - o. Glazing
 - p. Metal studs
 - q. Gypsum board
 - r. Acoustical tile and panels
 - s. Carpet
 - t. Carpet pad
 - u. Demountable partitions
 - v. Equipment
 - w. Cabinets
 - x. Plumbing fixtures
 - y. Piping
 - z. Supports and hangers
 - aa. Valves
 - bb. Sprinklers
 - cc. Mechanical equipment
 - dd. Refrigerants
 - ee. Electrical conduit
 - ff. Copper wiring
 - gg. Lighting fixtures

- hh. Lamps
- ii. Ballasts
- jj. Electrical devices
- kk. Switchgear and panelboards

2. Construction Waste:

- a. Masonry and CMU
- b. All untreated wood, including lumber and finish materials
- c. Wood sheet materials
- d. Wood trim
- e. Metals
- f. Insulation
- g. Carpet and pad
- h. Gypsum board
- i. Unused (leftover) paint
- j. Piping
- k. Electrical conduit
- l. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper
 - 2) Cardboard
 - 3) Boxes
 - 4) Plastic sheet and film
 - 5) Polystyrene packaging
 - 6) Wood crates
 - 7) Plastic pails
- m. Beverage and packaged food containers

1.05 SUBMITTALS

- A. Construction Waste Management Plan (CWMP): It is the intent of this specification to maximize the diversion of demolition and construction waste from landfill disposal. Accordingly, not more than 10 days after receipt of Notice to Proceed and prior to the generation of any waste, prepare and submit a draft Construction Waste Management Plan in accordance with this Section including, but not limited to, the following:
 - 1. Procedures for Recycling/Reuse Program to divert a minimum of 30% (by weight) of construction and demolition waste from landfill disposal, including waste resulting from demolition of any existing building and site paving scheduled for demolition; any site paving is required to be ground on site and reused as granulated fill on site.
 - 2. Approval of the Contractor's CWMP shall not relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures.
- B. Submit a 3-ring binder with calculations on end-of-project recycling rates, salvage rates, and landfill rates itemized by waste material, demonstrating that a minimum of 30% of construction wastes were recycled or salvaged and diverted from landfill. Include documentation of recovery rate (if commingled), waste hauling certificates or receipts, and a brief narrative explaining how and to where each waste type has been diverted.
- C. Construction Waste Management Plan: Submit four (4) copies of plan within 20 days of date established for the Notice to Proceed.
- D. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit four copies of the following reports:
 - 1. Project Demolition.
 - 2. Project Construction Waste.

Include separate reports for demolition and construction waste. Include the following information in each Waste Reduction Progress Report:

1. Material category.
 2. Generation point of waste.
 3. Total quantity of waste in tons.
 4. Quantity of waste salvaged, both estimated and actual in tons.
 5. Quantity of waste recycled, both estimated and actual in tons.
 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
 8. Include up-to-date records of donations, sales, recycling and landfill/incinerator manifests, weight tickets, hauling receipts, and invoices.
- E. Waste Reduction Calculations: Before request for Substantial Completion, submit four copies of calculated end-of-project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work. Complete a table similar to the example below.

Recycled/Salvaged/Diverted Materials	Hauler or Location	Quantity of Material (tons)
Total Construction Waste Diverted		
Landfilled Materials		
Total Construction Waste Landfilled		

Total Construction Waste		Total Construction Waste Diverted + Total Construction Waste Landfilled
Percentage of Construction Waste Diverted from Landfill		$(\text{Total Construction Waste Diverted} / \text{Total Construction Waste}) * 100$

- F. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax-exempt.

- G. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax-exempt.
- H. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- I. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills (or transfer stations) and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with all applicable local ordinances and regulations.
- B. Waste Management Meetings: Conduct an initial conference at project site. Contractor shall include discussions on construction waste management requirements in the pre-construction meeting. Contractor shall include discussions on construction waste management requirements in the regular progress meetings conducted during the course of the project; at these meetings, review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of the Waste Management Coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.07 CONSTRUCTION WASTE MANAGEMENT PLAN

- A. General: Develop and implement a CWMP consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume, but use the same units of measure throughout the CWMP.
- B. Draft Construction Waste Management Plan: Within 20 days after receipt of Notice to Proceed, or prior to any waste removal, whichever occurs sooner, the Contractor shall submit to the Owner and Architect a Draft Waste Management Plan.
- C. Final Construction Waste Management Plan: Once the Owner has determined which of the recycling options addressed in the draft Waste Management Plan are acceptable, the Contractor shall submit, within 10 calendar days, a Final Waste Management Plan.
- D. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- E. Landfill Options: Indicate the name of the landfill(s) and/or transfer station(s) and/or incinerator(s) where trash will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all Project waste in the landfill(s).
- F. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, reused, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 6. Handling and Transportation Procedures: Describe method that will be used for separating recyclable waste, including sizes of containers, container labeling, and designated location on Project Site where materials separation will be located.
- G. Materials: The following list of required materials, at a minimum, must be included for salvaging/recycling:
1. Cardboard
 2. Clean dimensional wood
 3. Beverage and food containers
 4. Paper
 5. Concrete
 6. Concrete Masonry Units (CMUs)
 7. Asphalt: Include the approximate weight of the asphalt paving to be crushed and utilized as granulated fill from the existing paving as a component of waste material diverted from the landfill.
 8. Ferrous and non-ferrous metals (banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze)
 9. Stretch and shrink wrap
 10. Gypsum wallboard
 11. Paint containers and other clean, empty plastic containers
- H. Meetings: Provide a description of the regular meetings to be held to address waste management.
- I. Materials Handling Procedures: Provide a description of the means by which any waste materials identified will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
- J. Transportation: Provide a description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 PLAN IMPLEMENTATION

- A. General: Implement waste management plan as approved by Architect and Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at the Project Site full-time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project Site.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project Site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Recycling and waste bin areas are to be kept neat, and clean, and clearly marked in order to avoid contamination of materials.
- E. Hazardous Wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations and should not be included in Construction Waste Management Plan's calculations of waste.

3.02 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Owner's Use:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- C. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

3.03 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:
 - 1. List to be developed by Contractor.
- C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project Site to the maximum extent practical.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project Site. Include list of acceptable and unacceptable materials at each container and bin.

- a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.04 RECYCLING DEMOLITION WASTE

- A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility or recycle on-site into new paving.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 1. Pulverize concrete to maximum 4-inch size.
 2. Crush concrete and screen to comply with requirements in Section 31 20 01 for use as satisfactory soil for fill or subbase.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 1. Pulverize masonry to maximum 1-1/2-inch size.
 - a. Crush masonry and screen to comply with requirements in Division 2 Section "Earthwork" for use as general fill or subbase.
 - b. Crush masonry and screen to comply with requirements in Division 2 Section "Exterior Plants" for use as mineral mulch.
 2. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, and panel products for reuse and/or recycling. Separate wood material treated with heavy metal preservatives for reuse or landfill disposal.
- E. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Gypsum Board: Stack large, clean pieces on wood pallets and store in a dry location for recycling off-site. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- G. Acoustical Ceiling Panels and Tile: Stack large, clean pieces on wood pallets and store in a dry location.
 1. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.
- H. Resin Countertops: Remove edge trim and non-fused pieces, inclusive of backsplash where possible.
- I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 1. Store clean, dry carpet and pad in a closed container or trailer provided by a carpet recycler or manufacturer-related carpet reclamation agency.
- J. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

- K. Plumbing Fixtures: Separate by type and size.
- L. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- M. Lighting Fixtures: Separate lamps by type and protect from breakage.
- N. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- O. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project Site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes: Chip brush, branches, and trees on-site.
- C. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into material appropriate for mulch or erosion control.
 - 2. Lumber Treated with Heavy-Metal Preservatives: Do not grind, chip, or incinerate; must be reused or landfilled.
- D. Gypsum Board: Stack large, clean pieces on wood pallets and store in a dry location for recycling and/or reuse on-site or off-site.
- E. Miscellaneous: Anything called out to be ground and used on site should utilize an on-site grinder.
 - 1. Grinder should be able to accommodate a variety of materials including masonry, asphalt, wood, and drywall.

3.06 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project Site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Do not burn or bury waste materials on or off site. Appropriate on-site topical application of ground gypsum or wood, or use of site paving as granulated fill is considered reuse, not waste.

END OF SECTION

SECTION 01 74 23

FINAL CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning Material.
- B. Cleaning.

1.02 RELATED SECTIONS

- A. Section 01 74 13 - Progress Cleaning.
- C. Section 01 77 00 - Closeout Procedures.
- C. Individual Specifications Sections and Notes: Specific cleaning for product or work.

1.03 DESCRIPTION

- A. Execute cleaning prior to inspection for Substantial Completion of each designated portion of the Work.
- B. Execute cleaning prior coordination with the owner and users of the occupied portion of the building.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

- A. Use materials which will not create hazards to health or property, and which will not damage surfaces.
- B. Use only materials and methods recommended by manufacturer of material being cleaned.

PART 3 EXECUTION

3.01 CLEANING

- A. In addition to removal of debris and cleaning specified in other sections, clean interior and exterior surfaces. Clean entire exterior of existing building and new work, including all surfaces.
- B. Remove temporary protection and labels not required to remain.
- C. Replace filters of the HVAC Systems
- D. Clean finishes free of dust, stains, films and other foreign substances.
- E. Clean transparent and glossy materials to a polished condition; remove foreign substances. Polish reflective surfaces to a clear shine.
- F. Vacuum clean carpeted and similar soft surfaces.

- G. Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction; in addition, clean ducts, blowers, and coils when units have been operated without filters during construction.
- H. Clean light fixtures and lamps.
- I. Maintain cleaning until Final Completion.
- J. Remove waste, debris, and surplus materials from site. Clean grounds; remove stains, spills, and foreign substances from paved areas and sweep clean. Rake clean other exterior surfaces.
- K. Pest Control: Engage an experienced exterminator to make a final inspection of the project and to rid the project of rodents, insects, and other pest.

END OF SECTION

SECTION 01 75 00

STARTING AND ADJUSTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Starting systems.

1.02 RELATED SECTIONS

- A. Section 01 40 00 - Quality Control
- B. Section 01 43 26 - Testing and Inspecting Agency.
- C. Section 01 75 10 - Demonstration and Training.
- D. Section 01 77 00 - Closeout Procedures.
- E. Divisions 21, 22 and 23.
- F. Division 26 and 28.

1.03 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify in writing the Owner's representative, Architect/ Engineer, and testing agency seven (7) days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
- D. Verify that each component of each system performs as designed and in conformance to manufacturer's recommendations to comprise complete and fully functional environmental systems.
- E. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- F. Verify wiring and support components for equipment are complete and tested i.e. electrical systems are properly open without restriction, all normally open positions are active, controls safely operational.
- G. All mechanical equipment shall be started and placed into operation by the manufacturer's authorized representative under the supervision of responsible Contractor's personnel and the Owner's representative. Any equipment requiring field assembly fabrication or wiring shall have such work done under the direct supervision of the manufacturer's representative. Prior to final approval, the Contractor shall submit letters of evidence from the manufacturer verifying conformance with these requirements.
- H. The operation and function of all air conditioning equipment and controls shall be fully understood by the air conditioning contractor's project representative. This representative shall be present at the site on a **full time** basis during start-up. Prior to final approval, contractor shall submit in triplicate copies of the "system start-up report". This report shall contain a daily log prepared by the project representative of all events involving the system during start-up.

PART 2 PRODUCTS
Not Used

PART 3 EXECUTION
Not Used

END OF SECTION

SECTION 01 75 10

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for demonstration of equipment operation and instruction of Owner's personnel.

1.02 RELATED SECTIONS

- A. Section 01 40 00 - Quality Control.
- B. Section 01 43 26 - Testing and Inspecting Agency.
- C. Section 01 75 00 - Starting and Adjusting.
- D. Section 01 77 00 - Closeout Procedures.
- E. Section 01 78 23 - Operation and Maintenance Data.
- F. Other and/or Individual Notes/ Sections: Specific requirements for demonstrating systems and equipment.

1.03 QUALITY ASSURANCE

- A. When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstrations and instructions have been completed.
- B. Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.04 SUBMITTALS

- A. Submit preliminary schedule for Architect/ Engineer and Owner's approval, listing times and dates for demonstration of each item of equipment and each system, two weeks prior to proposed dates.
- B. Submit reviewed and approved by Architect/ Engineer/ Owner the O&M Manuals two (2) weeks prior to scheduled demonstrations.
- C. Submit reports within one week after completion of demonstrations, that demonstrations and instructions have been satisfactorily completed. Give time and date of each demonstration, and hours devoted to demonstration, with a list of persons present, signed by the attendants.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify equipment has been inspected and put into operation in accordance with Section 01 75

00; testing, adjusting, and balancing has been performed and equipment and systems are fully operational.

- B. Have copies of completed operation and maintenance manuals at hand for use in demonstrations and instructions.

3.02 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of final inspection. For equipment requiring seasonal operation, perform instructions for other seasons within nine months.
- B. Use operation and maintenance manuals and HVAC test and balance reports as basis of instruction. Review contents of manual and reports with personnel in detail to explain all aspects of operation and maintenance.
- C. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at equipment location.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Substantial completion.
- B. Final completion.
- C. Re-inspection fees.
- D. Closeout submittals.
- E. Statement of Adjustment of Accounts.
- F. Application for Final Payment.

1.02 RELATED SECTIONS

- A. Section 01 11 00 - Summary of Work.
- B. Section 01 29 00 - Payment Procedures.
- C. Section 01 40 00 - Quality Control.
- D. Section 01 43 26 - Testing and Inspecting Agency.
- E. Section 01 74 23 - Final Cleaning.
- F. Section 01 78 23 - Operation and Maintenance Data.
- G. Section 01 78 36 - Warranties.
- H. Section 01 78 39 - Project Record Documents.
- I. Section 01 78 43 - Spare Parts and Extra Materials.

1.03 PRE-CLOSEOUT CONFERENCE

- A. The Contractor and his major subcontractors shall attend a pre-closeout conference with the Owner and Architect to review, and schedule the contractual obligations such as the substantial completion inspection, punch list, temporary certificate of occupancy, certificate of occupancy, final cleaning, project record documents, operations and maintenance data, spare parts, and closeout certificates.
- B. The Owners Representative shall prepare minutes from the conference and shall make distribution to all attendees.

1.04 SUBSTANTIAL COMPLETION

- A. Courtesy Walk: Notify the Owner and Architect Twenty (20) days prior to the anticipated

courtesy inspection. When the Contractor considers the Work or a designated portion of the Work nearly complete, he may submit a written request to the Architect and Owner to walk the Project with the Contractor. The Architect will select various rooms or portions of the project at random, pointing out typical deficiencies and describing quality and level of work which will be required to at the time of Substantial Completion inspection.

- B. Written Notice: When Contractor considers the Work or a designated portion of Work substantially complete, he shall submit two weeks written notice to the Architect and Owner requesting the Substantial Completion inspection.
- C. The Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected at least one week prior to the scheduled substantial completion inspection. The Contractor shall proceed promptly to complete and correct items on the list to cover, if not all, the majority of them.
- D. Upon receipt of the Contractor's deficiency list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete.
- E. Substantial Completion Inspection: The Architect will inspect the project with the Contractor and Owner in attendance.
- F. Deficiencies will be noted and a comprehensive list of items to be completed or corrected shall be prepared by the Architect and submitted to the Contractor for immediate completion or correction.
 - 1. The Contractor shall have 30 days from the Substantial Completion Date to complete or correct all items listed in the deficiency list.
- G. During the inspection, should the list become too extensive in the judgment of the Architect to constitute Substantial Completion, the inspection may be terminated and the Contractor notified in writing.
- H. Should the Architect find the Work is substantially complete, and after reviewing the deficiencies list, a Certificate of Substantial Completion shall be prepared in accordance with provisions of the General Conditions of the Contract Documents. The list of deficiencies shall be attached to the Certificate of Substantial Completion.
- I. Should the Architect's inspection find Work that is not substantially complete, he will promptly notify Contractor in writing, listing observed deficiencies.
- J. Contractor shall remedy deficiencies and send a second written notice of Substantial Completion.
- K. When the Architect finds the Work is Substantially Complete a Certificate of Substantial Completion will be prepared in accordance with provisions of Contract Documents.
- L. Submit certificates of Contractor and Subcontractors, certifying that products repaired, refinished, furnished and installed do not contain asbestos.
- M. All outstanding payments due, including retainage, with any interest due, shall be paid within 30 days of the Owner occupying or partially occupying a portion of the project. The amount paid must be in the proportion that the value of the portion of the work which is used or occupied bears to the total value of the work. However, the Owner may withhold from a progress payment or retainage payment an amount sufficient to pay the expenses the Owner reasonably expects to incur as a result of the Contractor's failure to correct or complete the work. The Owner will provide written notice to the Contractor of the amount being withheld and an explanation of the reason the amount is being withheld. The Contractor shall provide written notice of the correction of the conditions that are the reasons for the withholding, signed by an authorized agent of the Contractor. Once written notice has been received and verified by the Owner, the Contractor may include the amount on next progress payment in

1.05 TEMPORARY CERTIFICATE OF OCCUPANCY

- A. Before the Temporary Certificate of Occupancy can be issued for the Project, the Contractor must submit proof to the Architect and Owner of the following requirements:
 - 1. The Contractor must have an approved inspection by the Authority Having Jurisdiction for sprinkler and fire alarm/life safety.
 - 2. All life/safety work must be inspected and passed by the Authority Having Jurisdiction as indicated on the Permit Card.
 - 3. The telephone system must be operational for fire alarm tie-in and emergencies.
 - 4. Certificate of Asbestos and Lead Paint Removal Completion issued by the Authority Having Jurisdiction.

1.06 CERTIFICATE OF OCCUPANCY

- A. Before the Certificate of Occupancy can be issued for the Project, the Contractor must submit proof to the Architect and Owner of the following requirements:
 - 1. Items 1 through 4 of the Temporary Certificate of Occupancy requirements must be obtained.
 - 2. HVAC balance report must be reviewed and approved by the mechanical consultant.
 - 3. Final sign-off approval on the Inspection Permit Card.

1.07 FINAL COMPLETION

- A. When Contractor considers Work is complete, submit written certification:
 - 1. Contract Documents have been reviewed.
 - 2. Work has been inspected for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents, and deficiencies listed with Certificate of Substantial Completion have been corrected.
 - 4. Equipment and systems have been tested adjusted, and balanced, and are fully operational.
 - 5. Operation of systems has been demonstrated to Owner's personnel.
 - 6. Work is complete and ready for final inspection.
- B. Should the Architect find Work incomplete, he will promptly notify Contractor in writing listing observed deficiencies.
- A. Contractor shall remedy deficiencies and send a second certification of final completion.

1.08 RE-INSPECTION FEES

- A. Should status of completion of Work require re-inspection by the Architect due to failure of Work to comply with Contractor's claims on initial inspection, Owner will deduct the amount of Architect's compensation for re-inspection services from final payment to Contractor.

1.09 CLOSEOUT SUBMITTALS

- A. Evidence of Compliance with requirements of governing authorities and entities, and utility companies:
 - 1. Certificate of Occupancy.
 - 2. Certificates of Inspection for the following: fire alarm, sprinkler, mechanical, and electrical systems.
 - 3. Certificate of Asbestos and Lead Paint Removal Completion issued by the Authority Having Jurisdiction.

4. Letters of Acceptance from the following: sanitation district, water district, electric company, gas company, and telephone company.
 5. Completion of Final Inspection Punch list items.
- B. Project Record Documents: Under provisions of Section 01 78 39.
 - C. Operation and Maintenance Data: Under provisions of Section 01 78 23.
 - D. Warranties and Bonds: Under provisions of Section 01 78 36.
 - E. Non-Use of Asbestos Certificates.
 1. Due one week PRIOR of the Owner's occupancy of the Project.
 - F. Spare Parts and Extra Materials: Under provisions of Section 01 78 43.
 - G. Keys and Keying Schedule: Under provisions of Section 08 71 00.
 - H. Contractor's Affidavit of Release of Liens (AIA G706A).
 - I. Consent of Surety Company to Final Payment (AIA G707).
 - J. Certificates of Insurance for Products and Completed Operations.

1.10 STATEMENT OF ADJUSTMENT OF ACCOUNTS

- A. Submit final statement reflecting adjustments to Contract Sum indicating:
 1. Original Contract Sum.
 2. Previous change orders.
 3. Changes under unit prices.
 4. Deductions for uncorrected work.
 5. Deductions for liquidated damages.
 6. Deductions for re-inspection fees.
 7. Other adjustments to Contract Sum.
 8. Total Contract Sum as adjusted.
 9. Previous payments.
 10. Sum remaining due.
- B. The Architect will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by change orders.

1.11 APPLICATION FOR FINAL PAYMENT

- A. Submit Application for Final Payment in accordance with provisions of the Contract Documents.
- B. Final payment will be made to the Contractor after all listed deficiencies have been corrected, all closeout submittals have been received, all certification(s) and/or authorization(s) from the Nevada State Labor Commission, (if applicable) and the State Industrial Insurance System (SIIS) have been received and approved by the Owner.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Format.
- B. Contents.
- C. Equipment and Systems.
- D. Submittals.

1.02 RELATED SECTIONS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 01 66 00 - Product Storage and Handling Requirements.
- C. Section 01 75 10 - Demonstration and Training.
- D. Section 01 77 00 - Closeout Procedures.
- E. Section 01 78 36 - Warranties.
- F. Individual Specifications Sections: Specific requirements for operation and maintenance data

1.03 QUALITY ASSURANCE

- A. Provide complete instruction manuals and data prepared by personnel experienced in maintenance and operation of described products.

1.04 FORMAT

- A. Provide data in the form of an equipment and system instructional manual.
- B. Binders: Commercial quality, 8-1/2 x 11 inch three-ring binders with hardback, cleanable, plastic covers; three inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; list title of Project and identify subject matter of contents.
- D. Arrange content by systems under section numbers and sequence of Specification Index of the Project Manual.
- E. Provide tabbed numbered fly leaf for each separate product and system, by corresponding number as listed in Specification Index of the Project Manual.
- F. Text: Manufacturer's printed data and Contractor provided documentation.
- G. Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.05 CONTENTS, EACH VOLUME

- A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- B. For each product or system: list names, addresses, and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Product data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use project Record Documents as maintenance drawings.
- E. Type text: as required to supplement product data.
- F. Additional requirements: as specified in individual product specification sections.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Each item of equipment and each system: include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- B. Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- C. Include color-coded wiring diagrams as installed.
- D. Operating procedures: include manufacturer's start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance requirements: include manufacturer's routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include sequence of operation by controls manufacturer.
- H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- I. Provide control diagrams by controls manufacturer as installed.
- J. Provide Contractor's coordination drawings, with color-coded piping diagrams as installed.
- K. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- L. Include specified Testing and Balancing reports.
- M. Additional requirements: as specified in individual product specification sections.

1.07 SUBMITTALS

- A. In accordance with Section 01 78 39, provide two (2) complete manuals containing all equipment and system manufacturer product data. Manual contents and organization shall be as required above.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance. Additional copies of any such documents shall also be provided in final manual.
- C. Non-Use of Asbestos Certificates shall be included with the Record Documents due upon the Owner's occupancy as required in Section 01 77 00.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

WARRANTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Warranties.
- B. Contractor's one-year warranty.
- C. Product and services warranties.
- D. Form of submittals.
- E. Preparation of submittals.
- F. Time of submittals.

1.02 RELATED SECTIONS

- A. Section 01 77 00 - Closeout Procedures.
- B. Section 01 78 23 – Operation and Maintenance Data.

1.03 WARRANTIES

- A. Warranties required by Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.
- B. Submit three (3) sets of volumes containing written warranties and related documents required by Contract Documents.
- C. If, within one (1) year after the date of Substantial Completion of the Work or designated portion thereof, or after the date of commencement of warranties established herein, or by terms of an applicable special warranty required by Contract Documents, any of the Work is found to be not in accordance with the requirements of Contract Documents, Contractor shall correct it promptly after receipt of written notification of such condition.
 - 1. This period of one (1) year shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work.
 - 2. This obligation shall survive acceptance of the Work under the Contract and termination of the Contract.
 - 3. Owner will give such notice promptly after discovery of the condition.
- D. Nothing contained in this Section shall be construed to establish a period of limitation with respect to other obligations within Contract Documents.
- E. Establishment of the time period of one (1) year as described herein relates only to the specific obligation of Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with Contract Documents may be sought to be enforced, not to the time within which proceedings may be commenced to establish Contractor's liability with respect to Contractor's obligations other than specifically to correct the Work.

1.04 CONTRACTOR'S ONE-YEAR WARRANTY

- A. Unless otherwise provided elsewhere in the Contract, all materials and equipment incorporated into any Work covered by the Contract shall be new and where not specified, of the most suitable grade of their respective kinds for their intended use, and all workmanship shall be in accordance with construction practices acceptable to Owner.
- B. Unless otherwise provided in the Contract, Contractor warrants all equipment, materials, and labor furnished or performed under this Contract against defects in design, materials, and workmanship (unless furnished by Owner), for a period of 12 months (unless longer guarantees or warranties are provided for elsewhere in Contract Documents in which case the longer periods of time shall prevail) from and after final acceptance under the Contract, regardless of whether the same were furnished or performed by Contractor or by any of Contractor's subcontractors of any tier. Upon receipt of written notice from Owner of any defect in any such equipment, materials, or labor during the applicable warranty period, due to defective design, materials, or workmanship, the affected item or parts thereof shall be redesigned, repaired, or replaced by Contractor at a time acceptable to Owner.
- C. Contractor shall perform such tests as Owner may require to verify that such redesign, repairs, and replacements comply with the requirements of this Contract. All costs incidental to such redesign, repair, replacement, and testing, including the removal necessary to gain access shall be borne by Contractor.
- D. Contractor warrants such redesigned, repaired, or replaced work against defective design, materials, and workmanship for a period of twelve (12) months from and after date of acceptance thereof.
 - 1. Should Contractor fail to promptly make the necessary redesign, repair, replacement, and tests, Owner may perform or cause to be performed the same at Contractor's expense.
 - 2. Contractor and Contractor's surety or sureties shall be liable for the satisfaction and full performance of the warranties as set forth herein.

1.05 PRODUCT AND SERVICES WARRANTIES

- A. Contractor warrants to Owner that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and the Work will conform with the requirements of Contract Documents.
- B. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective.
- C. The Contract warranty excludes remedy for damage or defect caused by abuse, modifications not executed by Contractor, improper or insufficient maintenance, improper operation, or evidence as to the kind and quality of materials and equipment.

PART 2 PRODUCTS

2.01 FORM OF SUBMITTALS

- A. Bind in commercial quality 8-1/2" three D-side ring binders with durable plastic covers.
- B. Cover: Identify each binder with typed or printed title WARRANTIES with title of project; name, address, and telephone number of Contractor and equipment supplier; and name of responsible company principal.

- C. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of Product or Work item.
- D. Separate each warranty with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List subcontractor, supplier, and manufacturer with name, address, and telephone number of responsible principal.
- E. Provide a summary of warranties indicating, as a minimum, the following information:
 - 1. Warranty start date.
 - 2. Warranty duration.
 - 3. Warranty end date.
 - 4. Serial Number and/or Product Number.
 - 5. Supplier/Manufacturer.
 - 6. Subcontractor name and contact information.

PART 3 EXECUTION

3.01 PREPARATION SUBMITTALS

- A. Obtain warranties, notarized and executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten (10) days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the date of Substantial Completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

3.02 TIME OF SUBMITTALS

- A. For equipment or component parts of equipment put into service during construction with Owner permission, submit documents within ten (10) days after acceptance.
- B. Make other submittals within ten (10) days after date of Substantial Completion, prior to final Application for Payment.
- C. For items of work for which acceptance is delayed beyond date of Substantial Completion, submit within ten (10) days after acceptance, listing the date of acceptance as the beginning of the warranty period.

END OF SECTION

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Maintenance of Record Documents.
- B. Submittal of Record Documents.

1.02 RELATED SECTIONS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 01 77 00 - Closeout Procedures.
- C. Individual Specifications Sections: Manufacturer's certificates and certificates of inspection.

1.03 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. In addition to requirements indicated by the Contract and General Conditions, maintain at the site one record copy of:
 - 1. Contract Drawings
 - 2. Specifications
 - 3. Addenda
 - 4. Change Orders and other modifications to the Contract
 - 5. Reviewed shop drawings, product data, and samples
 - 6. Inspection certificates
 - 7. Manufacturer's certificates
- B. Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage for record documents and samples.
- C. Label and file record documents and samples in accordance with section number listings in Table of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- D. Maintain record documents in a clean, dry and legible condition. Do not use record documents for construction purposes.
- E. Keep record documents and samples available for inspection by Architect.

1.04 RECORDING

- A. Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
 - 1. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
 - 2. Field changes of dimension and detail.
 - 3. Changes made by modifications.
 - 4. Details not on original contract drawings.
 - 5. References to related shop drawings and modifications.
 - 6. Daily record information on a set of black line opaque drawings, and in a copy of a Project Manual, provided by Owner.
- B. Specifications: legibly mark each item to record actual construction, including:

1. Manufacturer, trade name, and catalog number of each product actually installed, particularly optional items and substitute items.
 2. Changes made by addenda and modifications.
 3. Daily record information on a set of blue line opaque drawings, and in a copy of a Project Manual, provided by Owner.
- C. Provide felt tip marking pens, maintaining separate colors for each major system, for recording information.
- D. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
- E. Other documents: maintain manufacturer's certifications, inspection certifications required by individual specifications sections.
- 1.05 SUBMITTALS
- A. At Contract closeout, deliver record documents and samples under provisions of Section 01 77 00 to the Architect.
- B. Record documents required, include but are not limited to the following list:
1. Record drawings.
 2. Record specifications.
 3. Record survey.
 4. Contractor's certified punch list.
 5. Record Submittals including shop drawings, product data and samples.
- C. Transmit with cover letter in duplicate, listing:
1. Date.
 2. Project title and number.
 3. Contractor's name, address, and telephone number.
 4. Number and title of each record document.
 5. Signature of Contractor or authorized representative.
 6. Record Submittals shall be organized and submitted in specification order.
- D. Contractor is to sign each sheet of the record drawings that are turned over to the Architect. Subcontractors are to sign their respective sheets of the Work.
- E. When the Architect has completed the reproducible record drawings the Contractor and his subcontractors (as appropriate) are to sign the reproducible before they are turned over to the Owner.
- F. Final payment to the Contractor is contingent on the satisfactory completion of items D and E above.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SPARE PARTS AND EXTRA MATERIALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Products required.
- B. Storage and delivery of products.

1.02 RELATED SECTIONS

- A. Section 01 66 00 - Product Storage and Handling Requirements.
- B. Section 01 77 00 - Closeout Procedures.
- C. Section 01 78 23 - Operation and Maintenance Data.
- D. Individual Specifications Sections: Specific spare parts and materials required.

1.03 PRODUCTS REQUIRED

- A. Provide quantities of products, spare parts, maintenance tools, and maintenance materials specified in individual sections to be provided to Owner, in addition to that required for completion of Work.
- B. Products: Identical to those installed in the Work. Include quantities in original purchase from supplier to avoid variations in manufacture.

1.04 STORAGE AND MAINTENANCE

- A. Store products with products to be installed in the Work, under provisions of Section 01 66 00.
- B. When adequate, secure storage facilities are available at site, capable of maintaining conditions required for storage and not required for Contract work or storage, spare products may be stored in available space.
- C. Maintain spare products in original containers with labels intact and legible, until delivery to Owner.

1.05 DELIVERY

- A. Coordinate with Architect and Owner. Deliver and unload spare products to Owner at project site and obtain receipt prior to final payment.

1.06 SCHEDULE OF SPARE PARTS AND MAINTENANCE MATERIALS
Spare parts and maintenance materials shall be as noted in each section.

PART 2 PRODUCTS
Not Used

PART 3 EXECUTION
Not Used

END OF SECTION

SECTION 02 00 00
SITE PREPARATION

1. GENERAL

1.1 DESCRIPTION

- A. The work includes, but is not limited to, site clearing and grubbing in preparation for needed grading and excavation for Exterior Generator work and Condensation Lines work.

1.2 SUBMITTALS

Not Used

1.3 REGULATORY REQUIREMENTS

- A. Dispose of debris and surplus soil in accordance with governing regulatory Agencies.
- B. Comply with applicable air pollution control regulations.
- C. Obtain permits for transportation of debris and surplus soil to disposal site, and dust permits.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Protect features remaining as final landscaping, and benchmarks and existing construction from damage or displacement.
- B. Maintain existing access for vehicles and pedestrian traffic.
- C. Add protection barriers and barricades as needed.

2. PRODUCTS

Not applicable.

3. EXECUTION

3.1 CLEARING

- A. Clear areas required for the construction of a Site Generator and Condensation Lines work.

- B. Remove the following except those designated to remain:
 - 1. Existing surface vegetation and other organic materials.
 - 2. Construction rubble and debris, existing fill or backfill, and unstable Soils.
 - 3. Materials dumped on site, loose caliche, rubble, wood, and other such items as directed by the Construction Project Representative.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Assume possession of materials being removed, unless indicated otherwise.
- E. Sprinkle area with water to prevent dust in accordance with local regulations.
- F. Brush and other cleared materials shall be removed from site and legally disposed of. No burning of materials is allowed on the site.
- G. Immediately upon discovery, remove and dispose of contaminated, vermin infested or dangerous materials by safe means so as not to endanger health of workers and public.
- H. Remove trees and shrubs within marked areas, clear undergrowth, and dead plant material.
- I. Remove demolished materials, tools, and equipment upon completion of work. Leave site in acceptable condition.
- J. Remove debris from Project site.

END OF SECTION

SECTION 02 41 00

SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Site and building demolition. Protection of existing and removal of indicated items, including, but not limited to:
 - 1. Construction and removal of temporary partitions, fencing, and protections.
 - 2. Identification of utilities.
 - 3. Capping, removal, relocation, and/or abandonment of designated utilities.
 - 4. Off-site disposal or recycling of demolition debris.
 - 5. Removal of asphalt and concrete paving.
 - 6. Removal of concrete curb work.
 - 7. Removal of building appurtenances. Fill in voids left by building demolition.
 - 8. Removal of natural and manmade landscape materials.

1.02 RELATED SECTIONS

- A. Division 1 - General Conditions.

1.03 HAZARDOUS MATERIALS:

- A. Before authorizing start of work, the Contractor shall have notified the Owner's Hazardous Materials Inspectors clearance stating that Hazardous Materials work is beginning. Asbestos removal is included in this contract.
- B. In the areas of work where lead-based paint is present, the Contractor is responsible for adhering to the OSHA Construction Standard for Lead (29 CFR 1926.62). It requires an initial determination concerning whether any employee may be exposed to lead at or above the action level.
- C. The Owner has established a hazardous materials abatement program. Should any other hazardous materials be encountered during the course of demolition, immediately notify the Owner and follow project requirements

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements, Codes, and Standards:
 - 1. Conform to applicable federal, state, and local codes for demolition work, health and safety requirements, dust control, and debris removal.
 - 2. Obtain required permits from authorities including but not limited to dust control permit, demolition permit, and storm water permit.
 - 3. ANSI A10.6 - Safety Requirements for Demolition.
 - 4. Requirements of affected utility companies.
 - 5. Conform to applicable codes for procedures when hazardous or contaminated materials are discovered.
- B. Structural Integrity: At all times maintain structural integrity of all items designated to remain.

1.05 SUBMITTALS

- A. Schedule: Per provisions of Section 01 33 00, submit sequence of demolition operations to Owner for review prior to start of work to prevent interruption of on-site business operations of buildings designated to remain.
 - 1. Coordinate shutoff, capping, continuation, abandonment, and/or new construction of utility services as required, together with details for dust and noise control protection.
- B. Shop Drawings: Indicate location and construction of temporary work, barricades and fences.
- C. Design Data: Submit calculations for bracing, shoring, and underpinning signed and sealed by a Professional Engineer in the State of Nevada.
- D. Project Record Documentation: Accurately record and submit actual locations of capped utilities, subsurface obstructions, and related details.

1.06 PROJECT CONDITIONS

- A. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.
- B. Notify Architect and Owner upon discovery of hazardous materials.
- C. Protections: Provide temporary barriers to protect Owner's personnel and the public from injury from demolition work.
 - 1. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.
 - 2. It is the Contractor's responsibility to furnish, install, and maintain throughout the demolition and utility relocation a substantial temporary fence around the site in order to ensure public safety and protect the site.
 - a. A substantial temporary fence is at a minimum, an 8-foot T-post fence with 6-foot chain link fabric and posts buried at least 18 inches, or an Owner-approved equivalent fence. The fence shall include a minimum of two locked gates, each with a minimum 20-foot width.
 - b. Maintain existing sidewalks to greatest extent possible.
 - c. If damaged during demolition work, the Contractor shall repair the fence.
 - 3. At the completion of demolition work, the substantial temporary fence shall be left in place for future school construction.
- D. Damages: Promptly repair damages caused to adjacent facilities by demolition work at no expense to the Owner.
- E. Traffic: Conduct operations and debris removal to ensure minimum interference with roads, streets, parking, walks, and other adjacent areas occupied or used facilities.
 - 1. Do not close, block, or otherwise obstruct streets, walks or parking facilities, of occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around obstructed traffic ways.
- F. Explosives: Explosives are not permitted at the site.
- G. Flame Cutting: Do not use cutting torches for removal until flammable materials are removed. At concealed spaces, verify conditions prior to flame cutting operations. Maintain portable fire suppression devices during flame cutting operations.

- H. Utility Services: Maintain utilities to off-site buildings designated to remain and protect against damage during demolition operations. Do not interrupt utilities serving buildings to remain, except when such utilities have been relocated and when authorized in writing by authorities having jurisdiction. All utilities to be relocated or removed by others should be notified at least 48 hours before demolition begins.
- I. Fire Protection: Maintain fire protection services during demolition operations. Coordinate work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas. Provide Fire Watch services as required by the project specifications.
- J. Environmental Controls:
1. The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent its operations from causing visible dust emissions from leaving the work areas. These measures shall include, but are not limited to, providing additional watering equipment, reducing vehicle speed on haul roads, restricting traffic on haul roads, and covering haul vehicles. The Contractor shall be responsible for any damage resulting from any dust originating from operations. The dust abatement measures shall be continued for the duration of the contract.
 2. The Contractor shall hose down any vehicle or equipment leaving the project area with water prior to entering the public right-of-way if the vehicles appear to be transporting excessive amounts of dust. When any material or debris is tracked out from the project area, the Contractor shall clean all paved public roads near the site entrances as often as required to prevent spreading of dust by vehicles.
 3. The Contractor shall comply with the regulations issued by the Clark County Department of Air Quality Management including, but not limited to the following:
 - a. Dust palliative application is required in bare soil areas that are left unattended for more than 30 days. Upon completion of the demolition work, the site may lay unattended for up to 10 weeks and portions of the site contain bare soil. Therefore, at the completion of demolition work, a dust palliative shall be applied to bare soil areas without Type II gravel. The Contractor shall be responsible for application of dust palliative as specified in the regulations.
 4. Comply with governing regulations pertaining to environmental protection.
 5. Do not use water when it may create hazardous or objectionable conditions.
 6. Upon completion of demolition, provide appropriate erosion control.
- K. Contractor is responsible for conforming to the demolition phasing plans as shown on Drawings. Any conflicts that require deviation from the approved phasing must be submitted and approved by the Owner and Architect.
- L. It is the Contractor's responsibility to coordinate and perform all demolition work in areas to accommodate new construction. Areas are to be cleaned and properly prepped to receive new work.
- M. Items indicated on the Drawings to be removed and reinstalled shall be carefully removed and temporarily stored in a climatized, weatherproof area as determined by the Owner. Any items that are damaged during the removal process shall be replaced or repaired to existing condition at no expense to the Owner. If items indicated to be removed and reinstalled are deemed unable to be removed without damage, inform the Owner and Architect for an approved direction.

- N. Access to/from the garden area, playgrounds, portables, and parking are to be maintained throughout demolition.
- O. If unforeseen conditions are discovered during demolition, report to Owner and Architect immediately for an approved scope of work.
- P. The Contractor is responsible for repairing or replacing any damage that exceeds the demolition scope indicated on the Drawings, at no additional cost to the Owner.

PART 2 PRODUCTS

As noted in applicable Sections.

PART 3 EXECUTION

3.01 EXISTING BUILDING DOCUMENTATION

- A. Document condition of adjacent site items, structure, and buildings that are to remain.
- B. Make arrangements with building owners and occupants to survey interior and exterior of existing buildings.
- C. Employ land surveyor to provide following documentation:
 - 1. Survey building exterior for position and elevation of principal elements before and after completion of demolition.
- D. Provide following graphic documentation:
 - 1. Photographically document existing building exterior before beginning demolition and after completing demolition.
 - 2. Identify photographs with date, time, orientation, and project identification.
 - 3. Deliver photographs to Owner with project record documents.

3.02 EXAMINATION

- A. Examine existing buildings indicated to be demolished before demolition.
- B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.
- C. Determine where demolition may affect structural integrity or weather resistance of adjacent buildings indicated to remain.
 - 1. Identify measures required to protect buildings from damage.
 - 2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings indicated to remain in structurally sound and weathertight and watertight condition.
- D. If applicable, verify hazardous material abatement is complete before beginning demolition.

3.03 PREPARATION

- A. Where applicable, provide shoring, bracing, or support to prevent movement, settlement,

or collapse.

- B. Locate, identify, stub off, and disconnect utility services indicated to be removed. Provide continuous service during business hours to buildings designed to remain.
- C. Protect existing landscape materials, trees, appurtenances, and structures indicated to remain.
- D. Erect and maintain temporary barriers and security devices for protection of the public and existing items indicated to remain.
- E. Notify affected utility companies before starting work and comply with utility's requirements.

3.04 DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent structures, off-site buildings, utilities, and parking lot designated to remain.
- B. Provide services for effective air and water pollution controls required by local authorities having jurisdiction.
- C. Conduct demolition with minimum interference to public or private access to occupied adjacent structures. Maintain egress and access at all times during school operating hours. Conform to phasing plans as indicated on Drawings.

3.05 DEMOLITION

- A. Perform demolition activities in a systematic manner.
- B. Demolish and remove foundation walls including footings. Break up and remove below grade concrete slabs and/or any associated structural elements for items shown to be removed on Drawings.
- C. Demolish and remove all items indicated on Drawings.
- D. If unanticipated mechanical, electrical, or structural elements conflicting with intended function or new construction are encountered, investigate and measure both the nature and extent of the conflict. Submit report to Owner in accurate written detail. Pending receipt of directive from Owner's Representative, rearrange demolition schedule as necessary to continue overall job progress without undue delay.
- E. Below Grade: Completely fill below grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 3 inches in diameter, roots, or other organic matter.
- F. Remove and dispose of natural and manmade landscape materials in landscaped areas designated to be demolished.

3.06 SALVAGED MATERIALS

- A. Recycling of Materials: Wherever possible, salvage materials for recycling or post construction use.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove debris and rubbish resulting from operations from site. Transport and legally dispose off site.
 - 1. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
 - 2. Burning of removed materials is not permitted on project site.
 - 3. Where possible, make use of recycling services and centers for demolished materials.

3.08 CLEANUP AND REPAIR

- A. Upon completion of work, remove tools, equipment, and demolished materials from site.
 - 1. Repair demolition performed in excess of what is required, at no additional expense.
 - 2. Return construction and surfaces to remain to condition existing prior to start of operations.
 - 3. Repair adjacent construction or surfaces damaged by the work.

END OF SECTION

SECTION 02 41 15
LANDSCAPE DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tree and Shrub Protection.
- B. Landscape Removal and Salvage.
- C. Grass Removal.
- D. Irrigation Removal.

1.02 RELATED SECTIONS

- A. Section 32 80 00 – Landscape Irrigation.
- B. Section 32 93 00 – Plants and Planting.
- C. Section 32 98 01 – Landscape Maintenance.

1.03 REGULATORY REQUIREMENTS

- A. Dispose of debris and surplus soil in accordance with governing regulatory agencies.
- B. Comply with applicable air pollution control regulations.
- C. Obtain permits for transportation of debris and surplus soil to disposal site, and dust permits.

1.04 SUBMITTALS

- A. Landscape Demolition Schedule: Proposed landscape demolition schedule indicating dates for each type and area of demolition for approval by Owner's Representative. Once accepted, revise dates only as approved in writing, after documentation for reasons for changes or delays.
- B. Submit any temporary irrigation systems or water methods and their schedule necessary for irrigating existing plants that are to remain during demolition and construction for approval by Owner's Representative.
- C. Submit all MSDS sheets for herbicides, pre-emergent & post-emergent products that are used for this project. The types of herbicides to be used and the methods of application shall confirm with the Environmental Protection Agency Policies.
- D. Provide notice seven (7) days before the application of herbicides, pre-emergent & post-emergent products, etc. to Owner's Representative.

1.05 PROJECT CONDITIONS

- A. Determine location of underground utilities and perform work in a manner which will avoid possible damage. Perform site survey, research public utility records, and verify existing utility locations. Hand excavate, as required. Determine and verify locations of irrigation system piping and components. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

- B. When demolition or conditions detrimental to plant growth or existing irrigation components that are to remain are encountered, notify Owner's Representative before continuing demolition. Notify Owner's representative of any discrepancies prior to commencing work.

1.06 SEQUENCING AND SCHEDULING

- A. Maintain uninterrupted water service to building during normal working hours. Arrange for temporary water shutoff with Owner.
- B. Provide temporary irrigation system, hand watering or other method of delivering water to existing plant material that is to remain during demolition and construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide materials and equipment necessary for the landscape demolition specified.
- B. Post-Emergent products. Application rates as per manufacture recommendations.
 - 1. Post-Emergent, Round Up
 - 2. Post-Emergent, Fusilade
 - 3. Post-Emergent, Poast
 - 4. Post-Emergent, Diquat
 - 5. Or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify location of existing utilities, existing sleeves, existing irrigation components and plants. Drawings indicate general location and arrangement of existing piping systems.
- B. Verify required utilities are available, in proper location, and ready for use.
- C. Verify available water supply water.

3.02 PREPARATION

- A. Mark trees within limit of work at waist height. Mark trees to remain with blue or green tree flagging ribbon. Mark trees to be removed with red or orange tree flagging ribbon. Contractor shall acknowledge color determination. Obtain Owner's Representatives approval prior to removal of trees.
- B. Mark all shrub and grass areas to be removed in an approved method. Areas are to be approved by Owner's Representative prior to removal. Identify shrubs to remain with blue or green flagging ribbon.
- C. Adjust irrigation controller to accommodate irrigation plan and schedule during demolition and construction.
- D. No storage of construction materials, fuel, solvents or toxic waste is to occur under or near plant material.

3.03 TREE AND SHRUB PROTECTION

- A. The contractor is to follow any and all industry standards and guidelines pertaining to the preservation of existing plant material.
- B. Failure to protect and preserve any existing plant material specifically designated as remaining on the site will result in the Contractor replacing damaged or dead plant with a plant of the same genus, species, size and form. Trees existing as a size greater than 48" box size, that are damaged, shall be replaced with trees with a minimum 60" box size.
- C. All trees and shrubs which are to be preserved shall be prominently signed to denote the intention of preservation during demolition.
- D. All Work under limb spread of any and all evergreens or low branching deciduous material shall be done by hand or by other methods so as to prevent damage to limbs or branches.
- E. Where it is necessary to excavate adjacent to existing trees, use all possible care to avoid injury to trees and tree roots. Excavation, in areas where 2-inch and larger roots occur, shall be done by hand. Roots 2-inches or larger in diameter, shall be tunneled under and shall be heavily wrapped with burlap to prevent scarring or excessive drying. Roots 1-inch and larger in diameter shall be painted with two coats of "Tree Seal". Exposed roots shall be covered to prevent undue desiccation.
- F. The stripping topsoil from around preserved trees shall not be allowed. Vegetation around existing trees requiring removal shall be cut at ground level rather than pulling out to avoid damage to roots.
- G. Avoid waterlogging situations. Protect all trees from situations in which standing water occurs due to compaction or damming of site due to structures or other situations.

3.04 LANDSCAPE REMOVAL

- A. Remove trees, shrubs and grass as identified to be removed, clear undergrowth and dead plant material.
- B. Remove shrubs in their entirety to a depth of 18 inches.
- C. Trees shall be removed including stumps and all roots greater than 2 inches to a minimum depth of 18".
- D. Remove existing decorative rock or salvage and stockpile for re-use. Re-use of decorative rock shall be approved by Owner's Representative.
- E. Remove boulders as identified on construction drawings.

3.05 GRASS REMOVAL

A. Preparation

- 1. Bermuda grass must be growing vigorously with nighttime temperatures consistently above 65 degrees Fahrenheit.
- 2. Water Bermuda grass regularly to promote growth.
- 3. Bermuda must be growing sufficiently to be mowed two times prior to herbicide application.
- 4. Notify the Owner's Representative seven (7) days prior to the use of any herbicide on the site.

B. Herbicide Application

- 1. Stop watering of Bermuda grass.

2. Apply initial application of herbicide per manufacturer's written instructions.
 - a. Protect existing trees, shrubs and other plant material scheduled to remain from damage caused by the use of the herbicide on the Bermuda grass.
 - b. Use heaviest recommended application rate.
 - c. Thoroughly cover all green leaf blade surfaces of the Bermuda grass.
3. Do not water Bermuda grass for two (2) weeks after initial application of herbicide.
2. Two weeks from initial application of herbicide, begin a regular watering schedule on the Bermuda and continue watering for two (2) more weeks.
3. Apply a second application of herbicide per manufacturer's written instructions.
 - a. Protect existing trees, shrubs and other plant material scheduled to remain from damage caused by the use of the herbicide on the Bermuda grass.
 - b. Use heaviest recommended application rate.
 - c. Thoroughly cover all green leaf blade surfaces of the Bermuda grass.
4. Discontinue all water on Bermuda grass after second application of herbicide.
5. Two weeks after second application of herbicide apply herbicide as needed to Bermuda grass which is still growing.
 - a. Spot spray Bermuda once a week as needed for four (4) weeks.
 - b. Protect existing trees, shrubs and other plant material scheduled to remain from damage caused by the use of the herbicide on the Bermuda grass.
 - c. Use heaviest recommended application rate.
 - d. Thoroughly cover all green leaf blade surfaces of the Bermuda grass.
- C. Turf and Soil Removal
 1. At the end of the four (4) week spot application of herbicide remove the turf base, roots and approximately 6"-7" of soil below the turf base depending on the thickness of the turf base for a total of 8" of material removed from the site.
 2. All removed Bermuda grass and soil is to be disposed of in a legal manner off site.
 3. Clean up all spillage, debris, roots, grass and other deleterious materials from the immediate working area and the surrounding site.
- D. Protection
 1. All trenching, digging, scraping or other work under limb spread of any and all evergreens or low branching deciduous material shall be done by hand or by other methods so as to prevent damage to limbs or branches.
 2. Where it is necessary to excavate adjacent to existing trees, use all possible care to avoid injury to trees and tree roots. Excavation, in areas where 2-inch and larger roots occur, shall be done by hand. Roots 2-inches or larger in diameter, except directly in the path of pipe or conduit, shall be tunneled under and shall be heavily wrapped with burlap to prevent scarring or excessive drying. Where a trenching machine is operated close to trees having roots smaller than 2-inches in diameter, a wall or trench adjacent to tree shall be hand trimmed, making clean cuts through roots. Roots 1-inch and larger in diameter shall be painted with two coats of "Tree Seal". Trenches adjacent to trees shall be closed within 24 hours, and when this is not possible, side of trench adjacent to tree shall be kept shaded with moistened burlap or canvas.
 3. Protect existing irrigation lines, wires, valves and other appurtenances that are to remain. Repair, replace or adjust any damaged irrigation equipment which is scheduled to remain in place. Make all repairs, replacements or adjustments immediately.
 4. Maintain continuous operation of existing irrigation system that is scheduled to remain during the entire duration of the scope of work. Immediately notify the owner's representative of any temporary water shut down or accidental damage.

3.06 IRRIGATION REMOVAL

- A. All preserved plants shall be provided with adequate supplemental irrigation if required. This includes the use of temporary irrigation systems, hand watering, watering trucks or other approved methods. Irrigation methods must be approved by Owner's Representative prior to the beginning of demolition work.
- B. Stub and cap irrigation lines where existing portions are being removed to prevent dirt and debris from entering the piping to remain.
- C. Remove and salvage existing irrigation components as directed on construction drawings. Preserve and protect existing irrigation components necessary for future irrigation and future irrigation connections.

3.07 CLEANING AND ADJUSTING

- A. During demolition work, keep public access areas and work areas in clean and orderly conditions.
- B. Maintain designated site access for vehicle and pedestrian traffic.
- C. Protect existing structures and hardscapes to remain and work and materials from damage due to landscape demolition operations, operations by other contractors and trades, and trespassers. Maintain protection during demolition periods. Treat, repair, or replace damaged areas as directed by Owner's Representative.
- D. Protect areas to receive future planting, and other features remaining as part of final landscaping.
- E. Immediately upon discovery, remove and dispose of contaminated, vermin infested or dangerous materials by safe means so as not to endanger health of workers and public.
- F. Backfill open pits and holes caused by demolition
- G. Remove demolished materials, tools and equipment upon completion of work. Leave site in acceptable condition, approved by Owner's Representative.

END OF SECTION

SECTION 03 11 00
CONCRETE FORMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Section 03 30 00 - Cast-In-Place Concrete: Supply of concrete accessories for placement by this Section.
- B. Section 05 50 00 - Metal Fabrications: Supply of metal fabrications for placement by this Section.
- C. Division 23: Supply of mechanical items for placement by this Section.
- D. Section 26 05 10 - Basic Electrical Requirements: Supply of electrical items for placement by this Section.

1.3 RELATED SECTIONS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.4 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ACI 347 - Recommended Practice for Concrete Formwork.
- D. PS-1 - Construction and Industrial Plywood.

1.5 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 347, 301, 318.
- B. Maintain one copy of each document on site.

1.7 REGULATORY REQUIREMENTS

- A. Conform to IBC, latest edition, for design, fabrication, erection and removal of formwork.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 45 17.

1.9 COORDINATION

- A. Coordinate work under provisions of Section 01 31 13.
- B. Coordinate this Section with other Sections of work which require attachment of components to formwork.
- C. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

- A. Form Materials: At the discretion of the Contractor.

2.2 PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- C. Pan Type: Steel of size and profile required.

2.3 FORMWORK ACCESSORIES

- A. Form Ties: Removable or Snap-off type, galvanized metal, fixed length, free of defects that could leave holes larger than one inch in concrete surface.
- B. Form Release Agent: Noxcrete, Silco Seal 2000F, or approved equal. The form-release agent shall not bond with, or adversely affect concrete surfaces and impair subsequent treatments of concrete surfaces.
- C. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- E. Waterstops: Rubber or Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, adequate width, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with Drawings.

3.2 EARTH FORMS

- A. Earth forming is not allowed on the exterior face of all footings and walls detailed to receive waterproofing under Section 07 13 26.
- B. Hand trim sides and bottom of earth forms. Remove loose soil and moisten prior to placing concrete.

3.3 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members which are not indicated on Drawings.

3.4 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in or passing through concrete work.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate work of other Sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts.
- D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install waterstops continuous without displacing reinforcement.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and

inspection. Locate openings at bottom of forms to allow flushing water to drain.

- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.6 FORM CLEANING

- A. Clean and remove foreign matter within forms as erection proceeds.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts or water to clean out forms, unless formwork and concrete construction proceed within heat enclosure. Use compressed air or other means to remove foreign matter.

3.7 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

3.8 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

3.9 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.

1.2 RELATED SECTIONS

- A. Section 03 11 00 - Concrete Forming.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 03 35 00 - Concrete Finishing: Reinforcement for concrete floor toppings.

1.3 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 318 - Building Code Requirements For Reinforced Concrete.
- C. ACI SP-66 - American Concrete Institute - Detailing Manual.
- D. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- E. ANSI/AWS D1.4 - Structural Welding Code for Reinforcing Steel.
- F. ANSI/AWS D12.1 - Reinforcing Steel Welding Code.
- G. AWS D12.1 - Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete Construction.
- H. CRSI 63 - Recommended Practice For Placing Reinforcing Bars.
- I. CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications and Nomenclature.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings:
 - 1. Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices.
 - 2. Submit rebar shop drawings for the cast-in-place concrete at the same time of those submittals.
- C. Submit welding certificates.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301, ACI SP-66, and ACI 318.
- B. Maintain one copy of each document on site.

- C. Submit certified copies of mill test report of reinforcement materials analysis.
- D. Submit welding qualifications.
- E. Special inspection is required for this work.

1.6 COORDINATION

- A. Coordinate work under provisions of Section 01 31 13.
- B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade for all bars #5 and larger and all bars used for concrete walls, beams, elevated slabs, and column primary reinforcing; reinforcing may be grade 40 (FY = 40 ksi) deformed bars for all bars #4 and smaller unless noted otherwise on Drawings or Details; deformed billet steel bars, plain finish. All reinforcing to be welded shall be ASTM A706, grade 60 low alloy weldable steel.
- B. Welded Steel Wire Fabric: ASTM A185 Plain Type in flat sheets or coiled rolls; plain finish.

2.2 ACCESSORY MATERIALS

- A. Accessory materials shall be manufactured in accordance with CRSI "Manual of Standard Practice".
- B. Tie Wire: Minimum 16 gage annealed type.
- C. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor barrier puncture.
- D. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Type M; size and shape as required.

2.3 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice ACI 318.
- B. Weld reinforcement in accordance with ANSI/AWS D1.4 and ANSI/AWS D12.1.
- C. Locate reinforcing splices not indicated on Drawings, at point of minimum stress. Review location of splices with Architect/Engineer.

PART 3 EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Conform to IBC, latest edition, for concrete cover over reinforcement.

3.2 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01 40 00.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place concrete floors, footings, foundations and walls.
- B. Slabs on grade.
- C. Vapor barrier.
- D. Cold, control, expansion and contraction joint devices associated with concrete work of this Section, including joint sealants.
- E. Equipment pads.

1.02 RELATED SECTIONS

- A. Section 01 73 29 - Cutting and Patching.
- B. Section 02 41 00 - Selective Demolition.
- C. Section 03 20 00 - Concrete Reinforcing.
- C. Section 03 35 00 - Concrete Finishing.
- D. Section 03 39 00 - Concrete Curing.
- E. Section 05 50 00 - Metal Fabrications.
- F. Section 07 90 00 - Joint Protection.
- G. Section 09 68 13 – Carpet Tile.
- H. Division 22 - Plumbing.
- I. Division 23 - Heating, Ventilating and Air Conditioning (HVAC).
- J. Division 26 - Electrical.
- K. Structural Drawings and Notes.

1.03 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 302 - Guide for Concrete Floor and Slab Construction.
- C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- D. ACI 305R - Hot Weather Concreting.

- E. ACI 306R - Cold Weather Concreting.
- F. ACI 308 - Standard Practice for Curing Concrete.
- G. ACI 318 - Building Code Requirements for Reinforced Concrete.
- H. ANSI/ASTM C618 - Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use as Mineral Admixture in Concrete.
- I. ANSI/ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- J. ANSI/ASTM D1190 - Concrete Joint Sealer, Hot-Poured Elastic Type.
- K. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- L. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- M. ASTM E 1745 - Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- N. ASTM E 1643 - Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- O. ASTM E96 - Water Vapor Transmission of Materials.
- P. ASTM C33 - Concrete Aggregates.
- Q. ASTM C94 - Ready-Mixed Concrete.
- R. ASTM C150 - Portland Cement.
- S. ASTM C494 - Chemicals Admixtures for Concrete.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Provide data on concrete mix designs divided into, and defined as, structural building and site related including aggregates, products and admixtures.
- C. Provide manufacturer's literature, installation, interfacing, coordination and instructions on vapor barrier.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 78 39.
- B. Accurately record actual locations of embedded utilities and components which are concealed from view. Dimension and annotate accordingly, including items that have been field placed at variance with the Drawings.
- C. Accurately record actual locations of found or existing utilities and components discovered and not identified on the Drawings.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.
- B. Maintain one copy of each document on site.
- C. Acquire cement and aggregate from same source for all work.
- D. Conform to ACI 305R when concreting during hot weather.
- E. Conform to ACI 306R when concreting during cold weather.
- F. Special inspection is required for this work.

1.07 LAYOUT

- A. Red pigment chalk is prohibited from use on or around all concrete surfaces.
- B. Use of this pigment color on concrete will result in defective concrete and will be required to be replaced.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Use one brand of cement throughout project unless otherwise acceptable to Architect.
 - 1. Cement: ASTM C150, Type V - Sulphate Resistant Portland type, unless otherwise noted.
 - 2. Fine and Coarse Aggregates: ASTM C33.
 - 3. Water: Clean and potable not detrimental to concrete.
- B. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.

2.02 ADMIXTURES

- A. Chemical: ASTM C494, Type A - Water Reducing.
- B. Fly Ash: ASTM C618, Class F. 18% maximum cement replacement by mass.

2.03 ACCESSORIES

- A. Bonding Agent: Two component modified epoxy resin.
- B. Vapor Barrier:
 - 1. Vapor Barrier membrane must have the following properties:
 - a. Minimum 10-mil thick polyolefin or polyethylene resin-based geomembrane.
 - b. Manufactured from ISO certified virgin resins.
 - c. Water Vapor Barrier ASTM E-1745 Meets or exceeds Class A
 - d. Water Vapor Transmission Rate ASTM E-96 0.006 gr./ft²/hr. or lower
 - e. Permeance Rating ASTM E-96 0.01 gr./ft²/hr. or lower

- f. Puncture Resistance ASTM E-1745 Minimum 2200 grams
- g. Tensile Strength ASTM E-1745 Minimum 45.0 lbf/in

2. Vapor Barrier Accessories:

- a. Seam Tape:
 - (1) High Density Polyethylene Tape with pressure sensitive adhesive, non-water soluble. Minimum width 4 inches.
- b. Fluid Sealant:
 - (1) Seal penetrations using pressure tape and complete seal using manufacturer's mastic.

3. Manufacturers:

- a. Stego Industries: Product - Stegowrap, 15 mil, Class A.
- b. Reef Industries: Product - VaporGuard.
- c. Substitutions: None.

4. Protection:

- a. Repair all damage to the vapor barrier per manufacturers recommendations

- C. Non-Shrink Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 5,000 psi in 28 days.

2.04 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler: ASTM D1752; Closed cell polyvinyl chloride foam, resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness.
- B. Construction Joint Devices: Integral galvanized steel, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge.
- C. Expansion and Contraction Joint Devices: ASTM B221 alloy, extruded aluminum; resilient neoprene filler strip with a Shore A hardness of 35 to permit plus or minus 25 percent joint movement with full recovery; extruded aluminum cover plate, of longest manufactured length at each location, flush mounted; color as selected.
- D. Membrane Curing Compound: Section 03 39 00.
- E. Sealant: Cold applied.

2.05 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ASTM C94, Alternative No. 3.
- B. Provide concrete to the following mix design:

<u>Concrete Use</u>	<u>Min. 28 Day Strength</u>	<u>Max. Aggregate Size</u>
Conventional slabs-on-grade	4500 psi	3/4"
Walls	4500 psi	3/4"
Footings	4500 psi	1-1/2"
Courtyard slabs	4500 psi	3/4"

Water/Cement Ratio (maximum):
0.45 by weight (mass) for 4500 psi concrete

Slump (plus or minus 1 inch):
4 inches (3 to 5 inches)

- C. Use accelerating admixtures in cold weather only when approved by Architect/Engineer. Use of admixtures will not relax cold weather placement requirements.
- D. Use set retarding admixtures during hot weather only when approved by Architect/Engineer.
- E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.
- C. Contractor to verify vapor barrier is not damaged or broken prior to concrete placement.

3.02 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301, ACI 305, ACI 306, ACI 318, ACI 614, IBC 1905, and ASTM C94.
- B. Notify the Architect and inspector a minimum of 48 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed joint fillers, joint devices and are not disturbed during concrete placement.
- D. Install vapor barrier under interior slabs, beneath and around building footings on grade per ASTM E-1643 and manufacturer's instructions. Lap joints minimum 6 inches and seal watertight with seam tape. Seal to foundation walls to provide continuous barrier.
- E. Repair vapor barrier damaged during placement of concrete reinforcing. Repair with vapor barrier material; seal tape manufacturer's fluid sealant; lap over damaged areas minimum 6 inches and seal watertight.

- F. Seal all penetrations and pipes with manufacturer's fluid sealant.
- G. Install joint fillers, primer and sealant in accordance with manufacturer's instructions.
- H. Separate slabs on grade from vertical surfaces and finishes with 1/4 inch thick joint filler and seal.
- I. Extend joint filler from bottom of slab to within 1/8 inch of finished slab surface.
- J. Install joint devices in accordance with manufacturer's instructions.
- K. Install joint device anchors. Maintain correct position to allow joint cover flush with floor and wall finish.
- L. Install joint covers in longest practical length, when adjacent construction activity is complete.
- M. Apply sealants in joint devices in accordance with Section 07 92 00.
- N. Maintain records of concrete placement. Record date, location, quantity, air temperature, test samples taken, and slump results.
- O. Place concrete continuously between predetermined expansion, control, and construction joints.
- P. Do not interrupt successive placement; do not permit cold joints to occur.
- Q. Saw cut joints are not permitted.
- R. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/8 inch in 10 ft.
- S. Concrete Age: No more than 90 minutes shall elapse between concrete batching and concrete placement unless approved by the engineer or authorized testing agency.
- T. Concrete Placement and Quality: Shall be per IBC Section 1905 and recommendations in ACI 614, ACI 301, ACI 309 and ACI 318. Mechanically vibrate all concrete when placed, except that slabs on grade need be vibrated only around floor tendon anchors, floor ducts etc. Cast closure pour, where shown on plans around columns after column dead load is applied. Remove all debris from forms before pouring. Do not vibrate forms or reinforcing steel.
- U. Segregation of Aggregates: Concrete shall not be dropped through reinforcing steel (as in walls, columns, and drop capitals) so as to cause segregation of aggregates. Unconfined fall of concrete shall not exceed 5 feet.
- V. Inserts: All items to be cast in concrete such as reinforcing, dowels, bolts, anchors, pipes, sleeves, etc., shall be securely positioned in the forms and existing conditions before placing the concrete.
- W. Control Joints: Unless approved otherwise, all concrete slabs on grade shall be bounded by keyed control joints such that the enclosed area does not exceed 260 sq. ft. Concrete slab on grade shall be bounded by keyed control joints as shown on Drawings. Ratio of boundary dimensions shall not exceed 1-1/2:1.
- X. Place all required reinforcement on chairs and supports.

- Y. Pipes: Pipes other than electrical conduits shall not be embedded in structural concrete except where specifically approved by the engineer. Maximum pipe size shall be 1/3 of the slab thickness and located at the mid depth. Minimum spacing shall be 3 times the pipe diameter. Pipes shall not impair the strength of the member.
- Z. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as herein specified.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- AA. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 - 3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
 - 4. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

3.04 CONCRETE JOINTS

- A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.
- B. Provide keyways at least 1-1/2" deep in construction joints in walls, slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
- C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.
- D. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.
- E. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
- F. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown.

- 3.05 CONCRETE FINISHING
- A. Refer to Section 03 35 00.
- 3.06 CURING AND PROTECTION
- A. Refer to Section 03 39 00.
- 3.07 FIELD QUALITY CONTROL
- A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01 40 00 and Section 01 43 26.
- B. Provide free access to Work and cooperate with appointed special inspection agency.
- C. Submit proposed mix design (separated as required) to Architect for review prior to commencement of Work, per Section 01 33 00.
- D. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.
- E. Three concrete test cylinders will be taken for every 75 or less cu yds of concrete placed.
- F. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. One slump test will be taken for each set of test cylinders taken.
- 3.08 PATCHING
- A. Notify and allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Honeycomb or embedded debris in concrete is not acceptable. Entire concrete panel, control joint to control joint, corner to corner, will be removed and replaced. Notify Architect/Engineer upon discovery. Architect will determine acceptability.
- C. Epoxy adhesive for patching concrete imperfections is not acceptable.
- 3.09 DEFECTIVE CONCRETE
- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, specified requirements, poor finish, or stained is required to be replaced corner to corner, joint to joint, as directed by Architect.
- B. Repair or replacement of defective concrete will be determined and at the discretion of the Architect/Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Section includes cast-in-place concrete, formwork, reinforcement, and accessories.
- C. Refer to Part 3.3.C of this Section for specified concrete finishes. No grout cleaned or plastered finishes shall be permitted or accepted.

1.2 RELATED SECTIONS

- A. Section 03 20 00 – Concrete Reinforcing.
- B. Section 03 30 00 – Cast-In-Place Concrete.
- C. Section 03 39 00 – Concrete Curing.

1.3 SUBMITTALS

- A. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Architect.
- B. Shop Drawings; Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- C. Architect's review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility.
- D. Samples: Submit samples of materials as requested by Architect, including names, sources, and descriptions.
- E. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test.
- F. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
- G. Applied, Cured Color Samples: Provide (3) pieces of each color to be installed for review and approval by the Architect before installation begins.
- H. Test Slab: Apply each color on site in a mechanical, or electrical room for review and approval by Architect before installation of scheduled areas begins.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 301 "Specifications for Structural Concrete for Buildings".
 - 2. ACI 318 "Building Code Requirements for Reinforced Concrete".
 - 3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".
- B. Testing Agency: Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in Part 3 of this section. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

1.5 PROJECT CONDITIONS

- A. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.
- B. Surface Protection: Protect adjacent finish materials against spatter during concrete placement.
- C. Environmental Conditions for Concrete to Receive Staining: Maintain an ambient temperature of between 50 and 90-deg F during application and at least 48 hours after application.
 - 1. Protection: Precautions shall be taken to avoid damage or contamination of any surfaces near the work zone. Protect completed stain work from moisture or contamination.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Floor Hardener:
 - 1. Day Chem Hardener; Dayton Superior.
 - 2. Surfhard; Euclid Chemical Co.
 - 3. Lapidolith; Sonneborn Building Products.
 - 4. Tamms Industries.
- B. Floor Sealer:
 - 1. Eucopoxy I; Euclid Chemical Co.
 - 2. Sonomar; Sonneborn Building Products.
 - 3. Colma Protective Coat; Sika Chemical.
 - 4. Tamms Industries.
- C. Floor Finishing:
 - 1. Spartan-Cote Cure-Seal Hardener.
 - 2. Burke.
 - 3. Chem Masters.
 - 4. Sonneborn.
 - 5. Tamms Industries.
- D. Self-Leveling Cement:
 - 1. Ardex K15; Ardex.
 - 2. Level Magic; Tamms Industries.
 - 3. Thoro Underlayment Self-Leveling; Thoro.
 - 4. System Products.
- E. Concrete Patching Cement:
 - 1. Recrete 20 Minute Repair; Dayton Superior.

2. Sika Set Fast Patch; Sika Corp.
3. Thorlite; Thoro Products.
4. Tamms Industries.

2.2 MATERIALS

A. Forms:

1. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
 - a. Overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class I.
 - b. Plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
 - c. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
 - d. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
 - e. Form Ties: Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to surface.
 - 1) Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface.

B. Reinforcing Materials:

1. Reinforcing Bars: ASTM A 615, Grade 60, deformed; or Grade 40 where specified.
2. Steel Wire: ASTM A 82, plain, cold-drawn steel.
3. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.
 - a. Flat.
 - b. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.
 - 1) For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2) For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

C. Concrete:

1. Portland Cement: ASTM C 150, Type I, typical unless noted otherwise.
 - a. Use one brand of cement throughout project, unless otherwise acceptable to Architect.
 - b. Fly Ash: ASTM C 618, Class F.
 - c. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
 - 1) For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
 - 2) Fine Aggregates shall comply with the following gradations:

Sieve	Percent passing
3/8"	100
No. 4	95 to 100

	No. 16	50 to 85
	No. 50	10 to 30
	No. 100	2 to 10
- 3) Course Aggregates shall comply with the following gradations:
- | | |
|--------|-----------------|
| Sieve | Percent passing |
| 1-1/2" | 100 |
| 3/4" | 90 to 100 |
| 3/8" | 25 to 55 |
| No. 4 | 0 to 10 |
| No. 8 | 0 to 5 |
- No. 200 Not to exceed 1.75 percent by weight in the combined course and fine aggregate.
- 4) Gradation limits: Maximum aggregate size shall not exceed the following requirements.
- (a) 1/5 narrowest dimension between forms.
 - (b) 1/3 of depth of slabs.
 - (c) 3/4 of minimum clear spacing between reinforcing bars.
- d. Lightweight Aggregates: ASTM C 330.
- e. Water: Drinkable.

D. Admixtures:

1. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
2. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.
3. Super Plasticizer: ASTM C 494, Type F or Type G and containing not more than 0.1 percent chloride ions.
4. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.
5. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.
6. Prohibited Admixtures: Calcium chloride thycyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

E. Accessories:

1. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gage galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
2. Waterstops: Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints as indicated. Size to suit joints.
 - a. Rubber Waterstops: Corps of Engineers CRD-C 513.
 - b. Polyvinyl Chloride Waterstops: Corps of Engineers CRD-C 572.
 - c. Non-Shrink Grout: Grout shall be prepackaged, non-metallic, non-gaseous. It shall conform to ASTM C 1107 Grade B or C at a fluid, flow cone, consistency. Fluid grout shall attain 6500 psi compressive strength in 28 days.
 - d. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
 - e. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
 - 1) Waterproof paper.
 - 2) Polyethylene film.
 - 3) Polyethylene-coated burlap.
 - f. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C 309, Type 1 or 1D Class B for interior and ASTM C 309 Type 2 Class A for exterior.
 - g. Bonding Compound: Polyvinyl Acetate (interior only) shall conform to ASTM C 1059 Type 1. Acrylic or styrene butadiene shall conform to ASTM C 1059 Type II.

- h. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.
- i. Evaporation Control: Monomolecular film designed to reduce rapid moisture loss during placement, float and finish operation.

2.3 MIXES

- A. Proportioning And Design of Mixes:
 - 1. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
 - 2. Submit written reports to Architect and Structural Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.
- B. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:
 - 1. 4500 psi 28-day compressive strength; W/C ratio, 0.45.
 - 2. 3000 psi 28-day compressive strength.
- C. Suspended Slabs: Proportion structural concrete mixture as follows:
 - 1. Minimum Compressive Strength: As indicated at 28 days.
 - 2. Calculated Equilibrium Unit Weight: As indicated, plus or minus 3 lb/cu. ft. (48.1 kg/cu. m) as determined by ASTM C 567.
 - 3. Slump Limit: As indicated on Structural Drawings.
 - 4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent and as indicated on structural drawings.
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.
- E. Admixtures:
 - 1. Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.
 - 2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
 - 3. Use high-range water-reducing admixture in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water/cement ratios below 0.50.
 - 4. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus-or-minus 1-1/2 percent as indicated.
 - 5. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.
 - 6. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
 - a. Subjected to freezing and thawing; W/C 0.50.
 - b. Subjected to deicers/watertight; W/C 0.45.
 - c. Subjected to brackish water, salt spray, or deicers; W/C 0.40.
 - d. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as indicated.

- F. Concrete Mixing:
1. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cu. yd., or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd., or fraction thereof.
 - a. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
 - b. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.
 - c. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

PART 3 EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.
- B. Preparation: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
- C. Installation Tolerances:
 1. Slabs: Minimum Flatness FF of 30 and Minimum Levelness FL of 25.
 2. Walls: Comply with ACI requirements for horizontal, vertical, and story to story tolerances.
- D. Preparation for Slabs to Receive Concrete Stain:
 1. Newly placed concrete shall be sufficiently cured to allow concrete to become reactive, minimum 14 days. (The 14 days curing time would also apply from the time concrete topping is applied at suspended composite floors.)
 2. If any of the following colors are used, the minimum cure time of the concrete shall be 30 to 60 days to meet water vapor transmission requirements.
 - a. Copper Patina.
 - b. Fern Green.
 - c. Weathered Bronze.
 - d. Do not use liquid curing materials. Cure concrete flatwork with new, unwrinkled, non-staining, high quality curing paper. Do not overlap curing paper.
 - e. Timing: Surfaces shall be cured using the same method and different sections (pours) chemically stained when the concrete is the same age.
 - f. Cleaning: Immediately prior to chemically staining, thoroughly clean the concrete. Sweep surfaces, then pressure wash or scrub using a rotary floor machine. Use suitable, high quality commercial detergents to facilitate cleaning. Rinse surfaces after cleaning until rinse water is completely clean. Allow floor to dry completely prior to application of floor stain.

3.2 ERECTION

- A. Forms: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported

by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

1. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
2. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
3. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
4. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
5. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
6. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
7. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.
8. Preparation of Form Surfaces:
 - a. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
 - b. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
 - c. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
 - d. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.3 INSTALLATION

- A. Reinforcement: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
 1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.
 2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
 3. Accurately position, support, and secure reinforcement against displacement by

- formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
4. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
 5. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

B. Concrete Placement:

1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.
2. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.
3. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
4. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
 - a. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
 - b. Do not vibrate forms or reinforcing steel.
 - c. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
 - 1) Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2) Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 - 3) Maintain reinforcing in proper position during concrete placement operations.
 - d. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as herein specified.
 - 1) When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.
 - 2) Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade

- containing frozen materials.
- 3) Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- e. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
- 1) Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
 - 2) Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 - 3) Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
 - 4) Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

C. Finish:

1. Rough Form Finish: Formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
2. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas.
3. Smooth Rubbed Finish: Provide smooth rubbed finish to concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.
 - a. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
4. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

D. Slab Finishes:

1. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
 - a. After placing slabs, plane surface to tolerances for floor flatness (F) of 15 and floor levelness (F) of 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.
2. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or

sand-bed terrazzo, and as otherwise indicated.

- a. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both, Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of F 18 - F 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
3. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
 - a. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of F 20 - F 17. Grind smooth surface defects which would telegraph through applied floor covering system.
4. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
5. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - a. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

E. Joints:

1. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.
2. Provide keyways at least 1-1/2" deep in construction joints in walls, slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
3. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.
4. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.
5. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
6. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8" x 1/4 slab depth or inserts 1/4" wide x 1/4 of slab depth, unless otherwise indicated.
 - a. Form contraction joints by inserting premolded plastic, hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
 - b. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
 - c. If joint pattern not shown, provide joints not exceeding 15' in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).

d. Embedded Items:

- 1) Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.
- 2) Install reglets to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
- 3) Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

F. Special Control Joints.

1. Provide special control joint cuts as indicated on drawings: Control joint pattern to be as indicated on the drawings.
2. Control Joint Profile: The control joint to be equal to joint made by 'Soff Cut International', 1112 Olympic Drive, Corona CA 92881, 1-800-776-3328.
3. The control joint to be XL-V21. The width to be 0.100" to 0.120" wide with a beveled profile that is 3/8" wide at the surface and slopes at a 45 degree angle for a depth of an 1/8".

G. Miscellaneous Concrete:

1. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
2. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
3. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
4. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled.

1.4 CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

1. Provide moisture curing by following methods.
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
 - d. Provide moisture-cover curing as follows:
 - 1) Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - e. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs, as follows:
 - 1) Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - 2) Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Architect.
2. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
3. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.
4. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.
5. Sealer and Dustproofer: Apply a second coat of specified curing and sealing compound only to surfaces given a first coat.

3.5 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.
- D. Re-Used of Forms:

1. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
2. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.6

CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.
1. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
 2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
 3. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
 4. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
 5. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
 6. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
 7. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
 8. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.
- B. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
1. Repair isolated random cracks and single holes not over 1" in diameter by dry-

pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

- C. Perform structural repairs with prior approval of Architect or Structural Engineer for method and procedure, using specified epoxy adhesive and mortar.

3.7 FIELD QUALITY CONTROL

- A. Sampling and testing for quality control during placement of concrete may include the following, as directed by Architect.
 - 1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 - b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
 - c. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, and when 80 deg F (27 deg C) and above; and each time a set of compression test specimens made.
 - d. Compression Test Specimen: ASTM C 31; one set of 5 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
 - e. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and two specimens retained in reserve for later testing if required.
 - 1) When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
 - 2) When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived by Architect if, in his judgment, adequate evidence of satisfactory strength is provided.
 - 3) When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 - 4) Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
- B. Test results will be reported in writing to Architect, Structural Engineer and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project

identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

- C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- D. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Initial and final curing of horizontal and vertical concrete surfaces.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete.
- B. Section 03 35 00 - Concrete Finishing.

1.3 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 302 - Recommended Practice for Concrete Floor and Slab Construction.
- C. ACI 308 - Standard Practice for Curing Concrete.
- D. ASTM C171 - Sheet Materials for Curing Concrete.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data on curing compounds, product characteristics, compatibility and limitations.
- C. Manufacturer's Installation Instructions: Indicate criteria for preparation and application.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Section 01 45 17.
- B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Membrane Curing Compound: ASTM C309 Type Class A and B, Acrylic dissipating resin type, clear without fugitive dye; Aqua Resin Cure as manufactured by Burke, Kure-n-Seal as manufactured by Sonneborn, or Master Seal by Master Builders. Not for use where sealers or ceramic tile are scheduled.
- B. Water: Potable and not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to be cured.

3.2 EXECUTION - HORIZONTAL SURFACES

- A. Cure floor surfaces in accordance with ACI 308.
- B. Spray water over floor slab areas and maintain wet for 7 days or apply membrane curing compound in accordance with manufacturer's instructions in 2 coats with second coat at right angles to first.

3.3 EXECUTION - VERTICAL SURFACES

- A. Cure surfaces in accordance with ACI 308.
- B. Spray water over surfaces and maintain wet for seven (7) days or apply membrane curing compound in accordance with manufacturer's instructions in two (2) coats with second coat at right angles to first.

3.4 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 45 17.
- B. Do not permit traffic over unprotected floor surface.

END OF SECTION

MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mortar and grout for masonry.

1.2 RELATED SECTIONS

- A. Section 09 24 00 - Portland Cement Plaster (Stucco).

1.3 REFERENCES

- A. ASTM C91 - Masonry Cement.
- B. ASTM C94 - Ready-Mixed Concrete.
- C. ASTM C144 - Aggregate for Masonry Mortar.
- D. ASTM C150 - Portland Cement.
- E. ASTM C207 - Hydrated Lime for Masonry Purposes.
- F. ASTM C270 - Mortar for Unit Masonry.
- G. ASTM C404 - Aggregates for Masonry Grout.
- H. ASTM C476 - Grout for Masonry.
- I. ASTM C780 - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- J. ASTM C1019 - Method of Sampling and Testing Grout.
- K. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Include design mix, indicate whether the Proportion or Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range to match each color of CMU. May be submitted in conjunction with the CMU mock-up.
- D. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780.
- E. Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.
- F. Submit manufacturer's certificate under provisions of Section 01450 that products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01655.
- B. Store and protect products under provisions of Section 01655.
- C. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.7 MIX TESTS

- A. Test mortar and grout in accordance with Section 01 43 26.
- B. Testing of Mortar Mix: In accordance with ASTM C780.
- C. Test mortar mix for compressive strength, mortar aggregate ratio, water content and air content.
- D. Testing of Grout Mix: In accordance with ASTM C1019.
- E. Test mortar mix for compressive strength and slump.
- F. Test mortar and grout along with masonry units per ASTM C1314 to confirm specified f'm is provided.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Portland Cement: ASTM C150, Type V; colors for reinforced unit masonry mortar to match CMU colors.
- B. Masonry Cement: ASTM C91, Type M or S, Type M shall be used where masonry is in contact with soil..
- C. Grout Aggregate: ASTM C404.
- D. Water: Clean and potable.

2.2 MORTAR MIXES

- A. Mortar for Reinforced Unit Masonry: ASTM C270, Type M or S using the Property Method. Color: Grey. 1800 psi (min) at 28 days.

2.3 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use "anti-freeze" compounds or any compound containing chlorides to lower the

freezing point of mortar.

- D. If water is lost by evaporation, retemper only within two hours of mixing.
- E. Use mortar within two hours after mixing at temperatures of 80 degrees F, or two-and-one-half hours at temperatures between 40 degrees F and 50 degrees F. Do not mix mortar when temperatures at time of application are less than 40 degrees F.

2.4 GROUT MIXES

- A. Bond Beams: 2000 psi strength at 28 days (unless noted otherwise in the drawings); 7-8 inches slump; mixed in accordance with ASTM C476 Course Grout.
- B. Engineered Masonry: 2000 psi strength at 28 days (unless noted otherwise in the drawings); 7-8 inches slump; mixed in accordance with ASTM C476 Course Grout.
- C. Grout strength shall be sufficient to achieve specified f'_m in prism tests.
- D. Epoxy grout shall be used to install all cap block.

2.5 GROUT MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C476 Course grout.
- B. Add admixtures in accordance with manufacturer's instructions. Provide uniformity of mix.
- C. Do not use "anti-freeze" compounds or any compound containing chlorides to lower the freezing point of grout.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Request inspection of spaces to be grouted.

3.2 PREPARATION

- A. Plug cleanout holes with block masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.

3.3 INSTALLATION

- A. Install mortar and grout to requirements of the specific masonry Sections.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches without consolidating grout by vibration.
- D. Do not displace reinforcement while placing grout.
- E. Remove grout spaces of excess mortar.

3.4 MORTAR JOINTS

- A. Above Grade - Light mortar wash finish.
- B. Below Grade - Flush joints.

END OF SECTION

SECTION 05 40 00

COLD FORMED METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior wall framing where indicated on drawings.
- B. Fascia and soffit framing.
- C. All headers in stud walls which are part of the work of this section.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 03 11 00 - Concrete Forming: Placement of anchors for securing the work of this Section.

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Section 08 41 13 - Aluminum Entrances and Storefronts: Anchors for support of framing.

1.4 RELATED SECTIONS

- A. Section 07 21 16 - Blanket Insulation: Insulation within framing members.
- B. Section 07 90 00 - Joint Protection.
- C. Section 09 21 16 - Gypsum Board Assemblies: Light weight, non-load bearing metal stud framing.
- D. Section 09 51 13 - Acoustical Panel Ceilings.
- E. Section 09 90 00 - Painting and Coating: Painting of exposed members.

1.5 REFERENCES

- A. AISI - American Iron and Steel Institute - Cold-Formed Steel Design Manual.
- B. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A446 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Physical (Structural) Quality.
- D. ASTM A525 - Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process.
- E. AWCI (Association of Wall and Ceiling Industries) - Specifications Guide for Cold-Formed Steel Structural Members.
- F. AWS D1.3 - Light Steel Welding Code.
- G. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.
- H. MFMA (Metal Framing Manufacturers Association) - Guidelines for the Use of Metal Framing.

1.6 SYSTEM DESIGN

- A. Non-bearing stud wall framing may be designed and submitted as a deferred submittal to the Architect for approval prior to acceptance.

1.7 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, welds, type and location of fasteners, and accessories or items required of related work.
- C. Indicate stud, ceiling and roof joist layouts.
- D. Describe method for securing studs to tracks and for bolted and welded framing connections.
- E. Provide product data on standard framing members; describe materials and finish, product criteria and limitation.
- F. Submit manufacturer's installation instructions under provisions of Section 01 33 23.
- G. Drawings and calculations for non-load bearing stud wall framing system design, if applicable.

1.8 QUALITY ASSURANCE

- A. Calculate structural properties of framing members in accordance with AWCI, MFMA, and AWS D1.3 requirements.
- B. Special inspection is required for all welding.
- C. Prepare shop drawings under the direct supervision of a Professional Structural Engineer licensed in the state of Nevada.

1.9 QUALIFICATIONS

- A. Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.10 COORDINATION

- A. Coordinate work under provisions of Section 01 31 13.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Allied Studco.
- B. Knorr Steel Framing System.
- C. Consolidated Fabricators.
- D. National Gypsum.
- E. Dietrich.

- F. Substitutions: Under provisions of Section 01 25 00.

2.2 FRAMING MATERIALS

- A. Studs: ASTM C955, galvanized structural quality sheet steel, formed to channel shape, punched web; 16 gage or as scheduled on Drawings, 6 inch or 3-5/8 inch face and 1-5/8 inch depth.
- B. Joists and Purlins: ASTM C955, galvanized structural quality sheet steel, formed to channel shape, solid web; 16 gage thick or as scheduled on Drawings, face and depth dimensions as detailed on Structural Drawings.
- C. Track: Formed steel; channel shaped; same thickness and width as studs and double deflection tracks.

2.3 ACCESSORIES

- A. Bracing and Bridging: Formed sheet steel, of same thickness as joists or studs.
- B. Plates, Gussets, Clips: Formed sheet steel, 3/16 inch thickness.
- C. Touch-Up Primer for Galvanized Surfaces: SSPC 20, Type 1, zinc rich.

2.4 FASTENERS

- A. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A123, hot-dip galvanized to .60 oz/sq ft.
- B. Anchorage Devices: Power actuated.
- C. Welding: In conformance with AWS D1.3.

2.5 FINISHES

- A. Studs: Galvanize to G60 coating class, conforming to ASTM A525.
- B. Tracks and Headers: Galvanize to G60 coating class, conforming to ASTM A525.
- C. Channels (Joists): Galvanize to G60 coating class, conforming to ASTM A525.
- D. Bracing, Furring, Bridging: Same finish as framing members.
- E. Plates, Gussets, Clips: Same finish as framing members.
- F. Finish Painting of Exposed Members: See Schedule in Paragraph 3.5.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surface conditions are prepared properly to receive work.

3.2 ERECTION OF STUDDING

- A. Install components in accordance with manufacturer's instructions.

- B. Align top and bottom tracks; locate to wall layout. Secure in place at 24 inches oc. Coordinate installation of sealant with bottom track.
- C. Place studs at 16 inches oc; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie or fastener method.
- D. Construct corners using minimum three studs. Double stud wall openings, door and window jambs.
- E. Erect load bearing studs, one-piece full length. Splicing of studs is not permitted.
- F. Erect load bearing studs, brace, and reinforce to develop full strength, to achieve design requirements.
- G. Install intermediate studs above and below openings to align with wall stud spacing.
- H. Attach cross studs to studs for attachment of fixtures anchored to walls.
- I. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- J. Touch-up field welds and damaged galvanized surfaces with primer for galvanized surfaces.
- K. Complete framing ready to receive interior gypsum board, backerboard.

3.3 ERECTION TOLERANCES

- A. Maximum Variation from True Position: 1/8 inch in 10 feet.
- B. Maximum Variation of any Member from Plane: 1/8 inch in 10 feet.

3.4 SCHEDULE OF FINISHING

- A. Interior Exposed Framing Members:
 - 1. Paint as scheduled in Section 09 90 00 – Painting and Coating.
 - 2. Color: As scheduled on Drawings.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shop fabricated ferrous metal items, galvanized and prime painted.
- B. Shop fabricated trench covers and framing.
- C. Shelf angles.
- D. Miscellaneous steel trim.
- E. Metal bollards.

1.2 RELATED SECTIONS

- A. Section 03 11 00 - Concrete Forming.
- B. Section 03 30 00 - Cast-In-Place Concrete.
- C. Section 05 40 00 - Cold Formed Metal Framing.
- D. Section 05 52 00 - Metal Railings.
- E. Section 09 90 00 - Painting and Coating: Paint finish.
- F. Section 12 36 61 - Countertops.

1.3 REFERENCES

- A. ASTM A36 - Structural Steel.
- B. ASTM A123 - Zinc Coatings on Iron and Steel Products.
- C. ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- D. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- E. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
- F. ASTM A325 - High Strength Bolts for Structural Steel Joints.
- G. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- H. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Pipe.
- I. AWS A2.0 - Standard Welding Symbols.
- J. AWS D1.1 - Structural Welding Code.
- K. SSPC - Steel Structures Painting Council.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. As a minimum, present the following shop drawings:
 - 1. Steel framing and support for mechanical and electrical equipment.
 - 2. Railings for mechanical equipment.
 - 3. Railings for special equipment.
 - 4. Brackets and supports for counters.
- C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.5 QUALIFICATIONS

- A. Welders' Certificates: Submit under provisions of Section 01 33 00, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.6 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Drawings.
- B. Special inspection is required for all welding.

1.7 COORDINATION

- A. Coordinate shop primers with topcoats to be applied to products. Comply with paint and coating manufacturer's written recommendations to ensure that shop primers and top coats are comparable with one another.
- B. Coordinate installation of metal fabrications that are anchored and/or receive other work. Furnish drawings, templates, and directions for all this work. Ensure on-time delivery of these items.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Steel Sections: ASTM A36.
- B. Steel Tubing: ASTM A500, Grade B and ASTM A501.
- C. Angles and Plates: ASTM A36.
- D. Pipe: ASTM A501.
- E. Bolts, Nuts, and Washers: ASTM A325 or A307 as specified galvanized to ASTM A153 for galvanized components.
- F. Welding Materials: AWS D1.1; type required for materials being welded.

- G. Touch-Up Primer for Galvanized Surfaces: SSPC 20, Type 1, zinc rich.
- J. Stainless Steel Sheet and Tubing - Austenitic 18-8, Type 304.

2.2 FABRICATION

- A. Fit and shop assemble in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Trench covers and frames are as manufactured by Architectural Art Manufacturing.

2.3 FINISHES

- A. Prepare all steel surfaces in accordance with SSPC SP-2.
- B. Shop prime steel items. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Galvanized items to minimum 1.25 oz/sq ft zinc coating in accordance with ASTM A123.
- D. Aluminum items - smooth plate mill finish aluminum.
- E. Stainless steel items - #4 commercial finish.
- F. Finish Paint: See Schedule, Paragraph 3.5.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on Drawings.
- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

3.5 SCHEDULE

- A. The Schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- B. Support Brackets for mechanical and electrical equipment as required.
- C. Bollards: Steel pipe, concrete filled, crowned cap; paint as scheduled in Section 09 90 00.
- D. Ledge and Shelf Angles, Channels and Plates Not Attached to Structural Framing.
- E. Ledge and Shelf Angles, Channels and Plates attached to Structural Walls.
- F. Stainless Steel Counter Support Framing: 2" x 2", 16 ga. steel channel.
- G. Counter Support Brackets: Steel, 5/16-inch thick x 2 inch bar stock or approved equal, formed into triangular closed bracket. Prime and paint as scheduled in Section 09 90 00 - Painting and Coating.
- H. Steel Tube Fence, Gate, and Screening Panel Frame Construction: Structural steel tubes as detailed. Paint as scheduled in Section 09 90 00. Color per Drawings.
- I. Trench Covers and Framing for Mechanical French Drains. Minimum: Steel Angle, 1" x 1" x 1/4" trench framing. Trench covers framing with 3/4" x 3/4" x 1/4" and 5/8" x 3/16" plates welded vertically to expose the thickness of the plate and/or as standard fabricated by Architectural Art Manufacturing or architect approved equal. Prime and paint as scheduled in Section 09 90 00 – Painting and Coating.

END OF SECTION

SECTION 05 52 00

METAL RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Steel tube and pipe handrails, and fittings.
- B. Steel bar guardrails and supports.
- C. Wire mesh panel guardrail infill panels.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 03 30 00 - Cast-In-Place Concrete: Placement of anchors in concrete.

1.3 RELATED SECTIONS

- A. Section 09 90 00 - Painting: Paint finish.

1.4 REFERENCES

- A. ASTM A36 - Structural Steel.
- B. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
- C. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- D. ADAAG - Americans with Disabilities Act Accessibility Guidelines, latest edition.
- E. SSPC - Steel Structures Painting Council.

1.5 DESIGN REQUIREMENTS

- A. Railing assembly, wall rails, and attachments to resist lateral force of 200 lbs at any point without damage or permanent set.
- B. Handrails to comply with size and wall clearance requirements of ADAAG.

1.6 SUBMITTALS

- A. Railing assembly, wall rails, and attachments to resist the required design loads per the standards and codes in Section 05 51 00, paragraphs 1.5 B and C, without damage or permanent set.
- B. Handrails to comply with size and wall clearance requirements of ADAAG.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Drawings and shop drawings.

PART 2 PRODUCTS

2.1 STEEL RAILING SYSTEM

- A. Steel Tubing: ASTM A500, Grade B.
- B. Pipe: ASTM A53, Grade B.
- C. Bars and Plates: ASTM A36.
- D. Guardrails and Posts: 1-1/2 inch diameter Schedule 40 steel pipe; welded joints.
- E. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast steel.
- F. Splice Connectors: Steel welding collars.
- G. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide for plain steel; SSPC 20, Type 1, zinc rich type for galvanized steel.

2.2 FABRICATION

- A. Fit and shop assemble components in largest practical sizes, for delivery to site.
- B. Fabricate components with joints tightly fitted and secured.
- C. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- D. Continuously seal joined pieces by continuous welds.
- E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- F. Accurately form components to each other and to building structure.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete, placed in partitions with setting templates, to

appropriate Sections.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Field weld anchors as indicated on shop drawings. Grind welds smooth. Immediately after erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/8 inch per vertical member.
- B. Maximum Offset From True Alignment: 1/8 inch in 10 feet.

3.5 FINISH SCHEDULE

- A. Pipe, tube, bar and wire mesh components, galvanized and plain; shop primed.
- B. Finish Painting: Paint as scheduled in Section 09 90 00.

END OF SECTION

SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hardware and Attachment accessories.
- B. Telecommunications terminal boards.
- C. Miscellaneous blocking and casework support construction.

1.2 RELATED SECTIONS

- A. Section 08 14 16 – Flush Wood Doors.
- B. Section 09 90 00 - Painting and Coating: Painting and finishing of exposed carpentry items.
- C. Section 12 35 53 – Metal Laboratory Casework: Upper cabinetry and Shelving work.

1.3 REFERENCES

- A. ANSI A208.1 - Mat Formed Wood Particleboard.
- B. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- C. ASTM E136 - Test Method for Behavior of Materials in a Vertical Tube Furnace.
- D. AWI - Quality Standards.
- E. AWP (American Wood Preservers Association) C20 - Structural Lumber Fire Retardant Treatment by Pressure Process.
- F. PS 1 - Construction and Industrial Plywood.
- G. PS 20 - American Softwood Lumber Standard.
- H. BHMA A156.9 - Cabinet Hardware.

1.4 SUBMITTALS

- A. Submit under provisions of Sections 01 33 00.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories to a minimum scale of 1-1/2 inch to 1 foot.
- C. Product Data: Provide certification of passing of Test Method ASTM E-136 for fire retardant treated materials.
- D. Provide instructions for attachment hardware and finish hardware.
- E. Samples:
 - 1. Hardwood plywood - 2 samples; 6 inch x 6 inch.
 - 2. Hardwood Trim - 2 samples; 12 inches long.

- 1.5 REGULATORY REQUIREMENTS
 - A. Conform to ASTM E-136 for fire retardant, flame spread and smoke development requirements.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver, store, protect and handle products to site under provisions of Section 01 66 00.
 - B. Protect work from moisture damage.
- 1.7 FIELD MEASUREMENTS
 - A. Verify that field measurements are as indicated on the shop drawings.
- 1.8 COORDINATION
 - A. Coordinate work under provisions of Section 01 31 13.
 - B. Coordinate the work with mechanical and electrical rough-in, installation of adjacent components, and paint work.
- PART 2 PRODUCTS
- 2.1 LUMBER MATERIALS
 - A. Softwood Lumber: PS 20; Douglas Fir species, plain sawn, maximum moisture content of 8 percent; with vertical grain; paint grade.
- 2.2 SHEET MATERIALS
 - A. Softwood Plywood: PS Grade C-D; veneer core; Douglas Fir face species, plain sliced.
- 2.3 FASTENERS AND HARDWARE
 - A. Fasteners: Of size and type to suit application; paint finish in concealed locations; countersink and plug in exposed locations.
 - B. Concealed Joint Fasteners: Threaded steel.
 - C. Casework Attachment to Walls: As recommended by SEFA 3 and SEFA 8.
- 2.4 ACCESSORIES
 - A. Lumber for Shimming, Blocking, and Shelving Grounds: Softwood lumber of Douglas Fir species.
- 2.5 WOOD TREATMENT PROCESSES
 - A. Fire retardant: Chemically treated and pressure impregnated; capable of providing a maximum flame spread/smoke development rating of 25/50 for plywood and dimensional

lumber in accordance with ASTM E84; and non-combustible certification in accordance with ASTM E-136. Preservatives containing arsenic or chromium are not to be used.

2.6 SHOP TREATMENT OF WOOD MATERIALS

- A. Shop pressure treatment to wood materials requiring UL fire resistive rating to telecommunications terminal boards.
- B. Provide UL approved identification on fire retardant treated lumber and sheet materials.
- C. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.
- D. Re-dry wood after pressure treatment to maximum 6 percent moisture content.

2.7 FABRICATION

- A. Fabricate to AWI, ANSI and PS standards as indicated.
- B. Shop assemble work for delivery to site, permitting passage through existing building openings.
- C. Fit exposed sheet material edges with 3/8 inch matching hardwood edging. Use one piece for full length only.
- D. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

- A. Install work in accordance with AWI Premium Quality Standards as indicated for materials being installed.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps. Woodwork with gaps larger than 1/32 inch must be removed and replaced.

3.3 PREPARATION FOR FINISHING

- A. Finishing: Refer to Section 09 90 00 – Paint and Coating.
- B. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.4 ERECTION TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

SCHEDULE

- A. Softwood Lumber:
 - 1. Shelving and Casework Supports: Douglas Fir No. 2; prepare for paint finish.
 - 2. Counter Support Wall Studs where required: Douglas Fir No. 2.
- B. Softwood Plywood:
 - 1. Telecommunications terminal boards: Douglas Fir; 3/4" thick; shop applied fire-retardant treatment.

END OF SECTION

SECTION 07 21 16

BLANKET INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Batt insulation in exterior furred chase wall, soffit and ceiling construction.
- B. Batt insulation in exterior metal stud wall construction.
- C. Batt insulation at interior sound partitions.

1.2 RELATED SECTIONS

- A. Section 05 40 00 - Cold Formed Metal Framing.
- B. Section 07 21 13 - Board Insulation.
- C. Section 07 84 00 - Firestopping.
- D. Section 09 21 16 - Gypsum Board Assemblies: Installation of acoustical insulation.

1.3 REFERENCES

- A. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- B. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

1.4 SYSTEM DESCRIPTION

- A. Materials of this Section shall provide continuity of thermal barrier at building enclosure elements.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data on product characteristics, performance criteria, and limitations.

1.6 COORDINATION

- A. Coordinate Work under provisions of Section 01 31 13.

PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

- A. Owens-Corning: Product - Flame Spread 25.
- B. Manville: Product - R-11 Thermal/Acoustical Batt for Acoustical Installation.
- C. Certainteed.
- D. Knauf Fiberglass Insulation.

- E. Substitutions: Under provisions of Section 01 25 00.

2.2 MATERIALS

- A. Batt Insulation: ASTM C-665 Type II; glass fiber batts; preformed, friction-fit type; faced on one side; Thickness as shown per drawings.
 - 1. Thermal Resistance: R of R19 or R15 as shown on drawings.
 - 2. Roll Size: 15-3/4" width or as required for fit between framing members.
 - 3. Facing: Faced on one side with polypropylene reinforced scrim.
 - 4. Flame/Smoke Properties: 25/50 per ASTM E84.
- B. Acoustical Insulation: ASTM C-665 Type I; glass fiber batts; preformed, friction-fit type; no-membrane surface; 3-1/2 inch thick, minimum.
- C. Tape: Polyethylene self-adhering type, 2 inch wide.
- D. Insulation Fasteners: Steel impale spindle and clip on flat metal base, self adhering backing, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place.
- E. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- F. Wire-up Restraining: 16 ga. galvanized steel wire.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

- A. Install insulation in accordance with insulation manufacturer's instructions.
- B. Install in wall spaces without gaps or voids.
- C. Trim insulation neatly to fit spaces.
- D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.
- E. Install facing of insulation facing any above ceiling plenum space. In no case shall fiberglass fibers be exposed to the atmosphere within plenums.
- F. Install vapor barrier facing warm side of building spaces. Lap ends of membrane between framing members.
- G. Tape ends and tears or cuts in membrane.
- H. Install wire-up restraints per insulation manufacturer's instructions; diagonally every 18 to 24 inches.

END OF SECTION

FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closed cell spray polyurethane foam.

1.2 RELATED SECTIONS

- A. Section 07 90 00 - Joint Protection.

1.3 REFERENCES

- A. ASTM C1029 – Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.
- B. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials (Also known as NFPA 255 and UL 723).
- C. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
- D. NFPA 285 – Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
- E. ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- F. ASTM D1622 – Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- G. ASTM D2126 – Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- H. ASTM E2178 – Standard Test Method for Air Permeance of Building Materials.
- I. NFPA 259 – Standard Test Method for Potential Heat of Building Materials.

1.4 PERFORMANCE REQUIREMENTS

- A. Material Performance: Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/m² @ 75 Pa.) when tested according to ASTM E2178.
- B. System Performance: Substantiate that air barrier material used as/in a system, will have an air permeance not to exceed 0.2 L/m² @ 75 Pa. when tested according to ASTM E2357.
- C. Connections to Adjacent Materials: Provide connections to prevent air leakage migration at the following locations:
 - 1. Foundation and walls, including penetrations, ties and anchors.
 - 2. Walls, windows, curtain walls, storefronts, louvers or doors.
 - 3. Different wall assemblies, and fixed openings within those assemblies.
 - 4. Wall and roof connections.
 - 5. Floors over unconditioned space.
 - 6. Walls, floor and roof across construction, control and expansion joints.

7. Walls, floors and roof to utility, pipe and duct penetrations.
8. All other leakage pathways in the building envelope.

1.5 QUALITY ASSURANCE

- A. All work is to be performed by applicators skilled in the application of polyurethane foam systems. Applicators shall have completed 5 similar projects over the last five (5) years and shall provide a list of these projects to the Owner or Owner's representative upon request.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Quality Assurance Program: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA) Quality Assurance Program (QAP). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).
- C. Product Data: Submit material manufacturer's product data and material manufacturer's instructions for evaluating preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
 1. Submit letter from primary air barrier material manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that manufacturer's material.
 2. Include statement from the primary air barrier material manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.
 3. Samples: Submit clearly labeled samples, 3 inch by 4 inch minimum size, of material specified.
- D. Compatibility: Submit letter from primary material manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from material manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.
- E. Air Barrier Subcontractor Qualifications: Air barrier subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA) whose installer(s) are certified in accordance with the site Quality Assurance Program used by ABAA.
 1. Closed cell, medium density sprayed polyurethane foam air barrier installer(s) shall be certified by BPQI (Building Performance Quality Institute) for the ABAA Quality Assurance Program in accordance with the requirements outlined in the QAP program used by ABAA. Installers shall have their photo-identification air barrier certification cards in their possession and available on the project site, for inspection upon request.

1.7 MATERIALS, DELIVERY AND STORAGE

- A. Materials shall be delivered in the manufacturer's original, tightly sealed containers or unopened packages clearly labeled with the manufacturer's name, product identification, safety information, approvals, and lot numbers where applicable.
- B. Containers shall be stored out of the weather and away from direct sunlight in a cool dry place at temperatures between 50 and 70 degrees F within the limits specified by the

materials manufacturer.

- C. All materials shall be stored in compliance with local fire and safety codes.

1.8 ENVIRONMENTAL CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Do not install spray polyurethane foam before the rook assembly has been sufficiently installed to prevent an accumulation of water in the interior of the building.
- B. Do not apply the polyurethane foam when substrate or ambient air temperatures are below 40 degrees F.
- C. Or above 120 degrees F and relative humidity is greater than 85 percent unless advance means and methods are recommended by the manufacturer.
- D. Do not apply polyurethane foam when wind velocity exceeds 15 miles per hour unless advance means and methods are recommended by the manufacturer. Use precautions to prevent damage to adjacent areas from fugitive overspray.

PART 2 PRODUCTS

2.1 MANUFACTURERS – SPRAY POLYURETHANE

- A. Certainteed.
- B. Gaco Western LLC.
- C. Demilec Inc.
- D. Substitutions: Under provisions of Section 01 25 00.

2.2 POLYURETHANE FOAM

- A. Material Properties:
 - 1. Material Air Permeance at 1 inch Thickness: 0.013
 - 2. Water Vapor Permeance (ASTM E96):
 - a. Water Method @ 2 inches: 1.1 US perms
 - 3. Core Density – Sprayed-in-Place (ASTM D1622): 2.0± pcf
 - 4. Compressive Strength – Parallel to Rise (ASTM D1621): 25 minimum
 - 5. Closed Cell Content (ASTM D2856): 90% minimum
 - 6. Aged R Value (ASTM C518), tested at 75 deg F: R at 1 Inch: 6.4
R at 3.5 Inches: 23.3

2.3 ACCESSORY MATERIALS

- A. Transition Membrane, Counter-Flashing, Primers, Substrate Joint Treatment, and Intumescent Coating: As recommended by manufacturer.

PART 3 EXECUTION

3.1 APPLICATION OF PRODUCTS

- A. The products intended for use in the building envelope insulation system and adjacent walls must be applied within the manufacturer's guidelines for temperature, humidity and

other atmospheric conditions. In addition, they must be sequenced so as to take into consideration substrate preparation, proper cure times and inter-pass adhesion.

3.2 EXAMINATION

- A. The spray foam contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with General Contractor, for compliance with the following requirements:
1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
 2. At the end of each working day, the General Contractor shall provide weather protection at the top of parapet walls and non-finished roofs to prevent moisture migration into walls and damage to installed air barrier systems.
 3. Verify that surfaces and conditions are suitable prior to commencing work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
 4. Ensure that the following conditions are met:
 - a. Surfaces are sound, dry, even, and free of excess mortar or other contaminants.
 - b. Inspect substrates to be smooth without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the concrete sub-trade.
 - c. Inspect masonry joints to be reasonably flush and completely filled, and ensure all excess mortar sitting on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the mason sub-trade. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263 and take suitable measures until substrate passes moisture test.
 5. Verify sealants are compatible with the proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
 6. Notify Architect in writing of anticipated problems using closed cell, medium density spray.

3.3 SURFACE PREPARATION

- A. The spray foam contractor shall ensure the substrate is clean, dust-free, dry and prepared in accordance with the air barrier material manufacturer's written instructions. The General Contractor shall be notified if this is not the case.
1. Ensure that penetrating work by other trades is in place and complete.
 2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale, rust and other contaminants which will affect adhesion of the closed cell, medium density spray polyurethane foam.
 3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges.
 4. Prime substrate for installation of sheet membrane transition strips if required by material manufacturer and as follows:
 - a. Prime masonry, concrete, glass-fiber surfaced gypsum sheathing, wood, metal, structural steel, sheet metal, and painted substrates with primers.
 - b. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and protrusions.
 5. Protection from Spray Polyurethane Foam:
 - a. Mask and cover adjacent areas and materials that aren't being sprayed to protect from overspray.
 - b. Ensure any required foam stop or backup material is in place and complete to prevent overspray and achieve complete seal.

- c. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes are removed from the spray location to exterior of the building. Provide for make-up air.
 - d. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.
- B. Substrate Preparation for Spray Polyurethane Foam:
 - 1. Steel:
 - a. Primed: If the primed metal surface is free of scale, rust or oils it normally does not require priming. Remove loose dirt or contaminants by power washing prior to application of polyurethane foam. Stainless steel requires primer.
 - b. Previously Painted: Clean the painted metal surface using hand or power tools to remove loose scale and rust. Grease, oil and other surface contaminants can be cleaned using a power washer.
 - c. Galvanized: Galvanized metals shall be clean and free of oils. Galvanized metal does not typically require primer.
 - 2. Concrete:
 - a. Must be cured, dry, and loose dirt and any other contaminants, including asphaltic materials, removed.
 - 3. Gypsum and Other Sheathing:
 - a. Most sheathing does not require priming; where required, primers shall be as recommended by the manufacturer.

3.4 STORAGE OF MATERIALS

- A. Materials shall be protected from freezing and should be stored in a controlled environment at a temperature of 50 – 70 degrees F.
- B. A and B chemical drum temperatures must be 60 – 80 degrees F before and during spraying for the drum to be serviceable (ready to spray). Material temperatures below 60 degrees F can result in proportioning errors and/or insufficient heat at the spray gun.

3.5 INSTALLATION

- A. Transition Strip Installation: Install air barrier accessories and spray polyurethane foam to provide continuity throughout the building envelope. Install materials in accordance with manufacturer's instructions.
 - 1. Apply primer for transition membrane at rate recommended by material manufacturer. Allow primer to dry completely before membrane application. Apply as many coats as necessary for proper adhesion.
 - 2. Position subsequent sheets of membrane applied above so that it overlaps the membrane sheet below by a minimum of 2.0 inches, unless greater overlap is recommended by material manufacturer. Roll into place with roller ensuring all transition membranes are free of fish-mouths, wrinkles, delaminations, bubbles and voids.
 - 3. Overlap horizontally adjacent pieces of membrane a minimum of 2.0 inches, unless greater overlap is recommended by material manufacturer. Roll all areas of membrane including seams with roller.
 - 4. Seal around all penetrations with termination mastic, extruded silicone sealant, membrane counter-flashing or other procedure in accordance with material manufacturer's recommendations.

3.6 PROTECTING AND CLEANING

- A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material manufacturer's written instructions.
 - 1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier material manufacturer.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the primary material manufacturer.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Through penetration smoke protection for all smoke partitions.
- B. Construction joint firestopping occurring within smoke partitions, floors, the intersection of smoke partitions to exterior walls, and the intersection of top of smoke partitions to roof deck.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 07 90 00 - Joint Protection.
- C. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard construction.
- D. Divisions 21, 22 and 23 - Mechanical.
- E. Division 26 - Electrical.

1.3 REFERENCES

- A. ASTM E84 - Standard Test Method for Surface Bearing Characteristics of Building Materials.
- B. ASTM E814 - Standard Test Method of Fire Tests of Through-Penetration Firestops.
- C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- D. UL 1479 - Standard for Fire Tests of Through-Penetration Firestops.
- E. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.
- F. UL - Fire Resistance Directory:
 - 1. Through Penetration Firestop Systems (XHEZ).
 - 2. Through Penetration Firestop Devices (XHJI).
 - 3. Fill, Void, or Cavity Material (XHHW).
 - 4. Joint Systems (XHBN).
 - 5. Perimeter Fire Containment Systems (XHDG).
 - 6. Fire-Resistance Ratings (BXRH).
- G. 2012 IBC with amendments.

1.4 DEFINITIONS

- A. Firestopping: A material or combination of materials placed in openings in a fire-rated assembly (wall, floor, etc.) or smoke partition to maintain the integrity of the fire-rating of that wall, floor, or other assembly, by arresting the movement of smoke or gasses through openings in that assembly.
- B. Firesafing: Stuffing material used as part of a firestop assembly to provide structural

support to the fluid-applied firestopping material.

- C. System: A specific firestop material or combination of materials in conjunction with a specific wall or floor construction type and a specific penetrant(s), as defined by a recognized testing laboratory.
- D. Barrier: Any wall, partition, enclosure, or floor that has an hourly fire and smoke rating.
- E. Through-penetration: Any penetration of a fire-rated wall, floor, or smoke partition that completely breaches the barrier.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. UL Tested Systems: Submit details from the UL Fire Resistance Directory (most recent edition) indicating the method of installation for each and every field condition.
- C. Product Data: Submit manufacturer's product data for each type of firestop material to be installed. Literature shall indicate preparation and installation instructions, product characteristics, performance and test data from the UL Fire Resistance Directory, where a tested system exists.
- D. Material Safety Data Sheets (MSDS): Submit MSDS for each firestop product.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Shop Drawings: Submit job specific shop drawings showing each condition requiring firestopping of a penetration or gap. Drawings must be in strict accordance with the tested firestopping system. Provide information on materials used, attachment, method of installation and relationship to all adjacent construction. Also submit shop drawings for any other areas where tested system data is unavailable, showing proposed materials, attachment and adjacent construction in accordance with manufacturer's data.
- G. Installers may submit firestopping data and shop drawing along with those of their primary trades.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- B. Installers: Contractors approved by the firestop manufacturer with minimum 5 years documented experience. All installers shall install firestopping compatible with that of other trades. General Contractor to coordinate these installations as to compatibility and Code compliance.

1.7 QUALITY ASSURANCE

- A. When project is ready for installation of through-penetration smoke protection, coordinate with the Architect to select an area to be used to demonstrate the installation methods and procedures for each type of condition. This mock-up area can be incorporated into the Work. Inspect smoke partitions.
- B. An inspection by third party Inspection and/or county having jurisdiction will be required for the annular space and backing material at penetrations prior to the installation of sealants.

1.8 REGULATORY REQUIREMENTS

- A. For penetrations and head-of-wall joint conditions in smoke resistive partitions required at incidental areas by 2012 IBC Section 302.1.1.1, firestop systems specified in this Section shall be installed or the Contractor may provide other penetration sealers along with project-specific engineering data proving compliance with the requirements of 2012 IBC 302.1.1.1 and acceptable to the governing building authorities.
- B. For unique firestop conditions not specifically conforming to previously tested and listed systems, the manufacturer must provide project-specific engineering data acceptable to the governing building authorities.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in manufacturer's original unopened containers, with intact product labels showing product name and number, batch number, date of manufacturer and handling precaution statements.
- B. Store products in weather protected environment, clear of ground and moisture.

1.10 ENVIRONMENTAL CONDITIONS

- A. Do not install materials when temperature or moisture conditions are outside the range of acceptable conditions as required by materials manufacturers.
- B. Assure that required conditions are maintained during material curing times.

1.11 PRE-INSTALLATION CONFERENCE

- A. Convene two weeks prior to commencing work of this Section.
- B. Provide two weeks written notice of time and date of meeting to Owner and Architect.
- C. Review installation procedures and coordination required with related work.
- D. Contractor to provide all UL (Underwriters Laboratories, Inc.) / WH (Warnock Hersey) approved application details for all intended installations.
- E. The following personnel are required to be in attendance:
 1. General Contractor's Superintendent.
 2. Prime Subcontractors involved.
 3. Third Party Inspections and/or County.
 4. Architect's Representative.

PART 2 PRODUCTS

2.1 GENERAL

- A. Firestopping sealants must be flexible, allowing for cyclical movement of building elements and for normal inertial pipe movement.
- B. Firestopping materials shall not shrink upon drying as evidence by cracking or pulling back from contact surfaces.
- C. All firestopping materials shall be moisture resistant and may not dissolve in water after curing.
- D. All firestopping materials shall be non-toxic, non-hazardous and lead or asbestos-free.

- E. Material used shall be in accordance with the manufacturer's written installation instructions.
- 2.2 ACCEPTABLE MANUFACTURERS - FOR USE IN UL LISTED FIRE RESISTIVE SYSTEMS
- A. Specified Technologies, Inc. (SpecSeal).
 - B. Hevi-Duty/Nelson.
 - C. Hilti.
 - D. Tremco.
 - E. 3M.
 - F. Metaline/Metacaulk.
 - G. Nuco Inc.
 - H. Substitutions under provisions of 01 60 00. Request to install systems using products not listed below must be accompanied by UL Assembly drawings indicating that the equivalent fire-resistive performance can be achieved with substituted products in walls or other areas requiring firestopping as shown on Drawings in order to be approved as an equivalent system.
- 2.3 SEALANT MATERIALS - FOR USE IN UL LISTED FIRESTOP OR HEAD-OF-WALL JOINT SYSTEMS
- A. Latex Intumescent Sealant:
 - 1. SpecSeal 100
 - 2. Nelson CLK.
 - 3. Hilti FS-ONE
 - 4. 3M Fire Barrier CP25WB+
 - 5. Tremstop - IA
 - 6. Or other latex intumescent sealants by above listed manufacturers.
 - B. Latex Non-Intumescent Sealant:
 - 1. SpecSeal LC-150
 - 2. Nelson LBC
 - 3. 3M Fire Dam 150
 - 4. A/D Fire Barrier Seal N/S
 - 5. Or other latex non-intumescent sealants by above listed manufacturers.
 - C. Firestop Putty:
 - 1. SpecSeal Firestop Putty
 - 2. Nelson FSP
 - 3. Metacaulk Fire Rated Putty
 - 4. 3M Fire Barrier Moldable Putty+
 - 5. Tremstop - FP
 - 6. Or other firestop putty by above listed manufacturers.
 - D. Wrap Strip:
 - 1. SpecSeal SSWRED
 - 2. Nelson WRS
 - 3. Metacaulk Wrap Strip
 - 4. 3M Fire Barrier FS-195+
 - 5. Tremstop - WS
 - 6. Or other wrap strip by above listed manufacturers.

- E. Mortar:
 - 1. SpecSeal Firestop Mortar
 - 2. Nelson CMP
 - 3. Hilti Firestop Mortar
 - 4. Metacaulk Fire Rated Mortar
 - 5. 3M Fire Barrier Mortar
 - 6. Tremstop - WBM
 - 7. Or other mortar by above listed manufacturers.
- F. Silicone Elastomeric Sealant:
 - 1. Pensil 300
 - 2. 3M Fire Barrier 2000+
 - 3. Metacaulk 835+
 - 4. A/D Fire Barrier Silicone N/S
 - 5. Or other silicone elastomeric sealants by above listed manufacturers.

2.4 SEALANT MATERIALS FOR USE IN WALL JOINTS

- A. Silicone Elastomeric Sealant:
 - 1. Hilti CP601S
 - 2. 3M Fire Barrier 2000+
 - 3. Metacaulk 835+
 - 4. Or other silicone elastomeric sealants by above listed manufacturers.

2.5 FIRESAFING MATERIALS

- A. Mineral Fiber Insulation: Density 3.5 lb/cu. ft. (min); compressible to 50% (min):
 - 1. Owens Corning Thermafiber.
 - 2. Rockwool.

2.6 ACCESSORIES

- A. Primer: Type recommended by sealant manufacturer for specific substrate surfaces.
- B. Installation Accessories: Metal clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place. Schedule 40 pipe sleeve required at all openings larger than 8 inches in diameter.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that environmental conditions are safe and suitable for installation of firestop products.
- B. Verify that all pipe, conduit, cable and other items which penetrate smoke partitions have been permanently installed prior to installation of firestops.
- C. Examine surfaces for conditions which would adversely affect execution, permanence and quality of work.
- D. If unsatisfactory conditions for installation exist, notify the Construction Manager.

3.2 INSTALLATION

- A. Surface Preparation: Remove all dust, dirt, oil and other foreign materials and contaminates from the application surfaces.

- B. Coordinate with third party Inspection and/or County having jurisdiction for the annular space inspection required by paragraph 1.7 B.
- C. Apply firestops in accordance with the fire test reports, fire resistance requirements and manufacturer's recommendations.
- D. Schedule and sequence the work to assure that partitions, ceilings, and other construction which would conceal penetrations are not erected prior to the installation of firestops.
- E. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
- F. Damming Construction: When required to properly contain firestopping materials within openings, damming or parking materials may be utilized. Remove all damming material after material has cured unless damming is a component of the listed system.
- G. Inspect areas to assure that all openings have been completely sealed. Perform all remedial sealing necessary to assure complete closure of all openings, per the UL listed assemblies.
- H. Finish visible surfaces flush and smooth as per details from the UL Fire Resistance Directory.

3.3 CLEANING

- A. Clean Work under provisions of Section 01 74 23.
- B. Clean adjacent surfaces of firestopping materials.

3.4 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 45 17.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 90 00
JOINT PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preparing substrate surfaces.
- B. Sealant and joint backing.
- C. Sealant at all dissimilar materials.

1.2 RELATED SECTIONS

- A. Sections 03 30 00 - Cast-in-Place Concrete and 03 47 13 – Tilt-Up Precast Concrete: Sealants required in conjunction with concrete.
- B. Section 07 84 00 - Firestopping - thru penetration firestopping at fire-rated and smoke partitions.
- C. Sections 08 11 13 – Hollow Metal Doors and Frames: Sealants required in conjunction with hollow metal doors and frames.
- D. Section 08 41 13 – Aluminum Framed Entrances and Storefronts: Sealants required in conjunction with aluminum entrances and storefronts.
- E. Section 08 80 00 - Glazing: Sealants required in conjunction with glazing methods.

1.3 REFERENCES

- A. ASTM C717 - Standard Terminology of Building Seals and Sealants.
- B. ASTM C834-14 - Standard Specification for Latex Sealants.
- C. ASTM C920-14a - Standard Specification for Elastomeric Joint Sealants.
- D. ASTM C962 - Standard Guide for Use of Elastomeric Joint Sealants.
- E. ASTM C1193-16 - Standard Guide for Use of Joint Sealants.
- F. ANSI/ASTM D1056-14 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- G. ANSI/ASTM D1565-76 - Standard Specification for Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).
- H. SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 00.

- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, precautions for protection of adjacent materials, perimeter conditions requiring special attention, and environmental conditions required for installation.
- D. Certification: Submit manufacturer's certification of compliance indicating that each product being furnished complies with these specifications, is recommended for the application indicated, and is compatible with the other materials in the joint system.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with SWRI requirements for materials and installation.
- B. Field Samples and Mockups:
 - 1. Provide samples of sealants and caulking compounds at locations coordinated with the Architect.
 - 2. Samples will be visually and manually examined by the Architect/Owner for joining, dirt pick up, shrinkage, color, work quality, and appearance.
 - 3. Schedule applications with allowance of sufficient curing time. Samples may need to be examined at least two (2) weeks prior of date scheduled for commencing the work.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Applicator: Company specializing in performing the work of this section with minimum three years documented experience.

1.7 COORDINATION

- A. Coordinate work under provisions of Section 01 31 13.
- B. Coordinate the work with the sections referencing this section.

1.8 SITE CONDITIONS

- A. Do not start installation of sealants and caulking during inclement weather, unless the installation complies with the manufacturer's instructions.
- B. Do not start installation of sealants under extreme temperature conditions that may cause joint openings to be near either maximum or minimum widths.
- C. Schedule installation of sealants and cure of them within reasonable temperatures and within manufacturer's recommended range of temperatures.

PART 2 PRODUCTS

2.1 SEALANTS

- A. Acrylic Emulsion Latex: ASTM C834, single component; non-sag; color to match adjacent surfaces.
- B. Butyl Sealant: ASTM C920, Class A, single component, solvent release, non-skinning, non-sagging, black color.
 - 1. Elongation Capability: 7 to 10 percent
 - 2. Service Temperature Range: -13 to 180 degrees F
 - 3. Shore A Hardness Range: 10 to 30
- C. Polysulfide Sealant: ASTM C920, Class A, two component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging, self-leveling type; grey color; paintable.
 - 1. Elongation Capability: 25 percent
 - 2. Service Temperature Range: -40 to 180 degrees F
 - 3. Shore A Hardness Range: 20 to 35
- D. Polyurethane Sealant: ASTM C920, Class A, single component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type; color to match adjacent surfaces.
 - 1. Elongation Capability: 25 percent
 - 2. Service Temperature Range: -40 to 180 degrees F
 - 3. Shore A Hardness Range: 20 to 35
- E. Silicone Sealant: ASTM C920, low modulus type, Class A, single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding; color to match adjacent surfaces.
 - 1. Elongation Capability: 25 percent
 - 2. Service Temperature Range: -65 to 180 degrees F
 - 3. Shore A Hardness Range: 15 to 35

2.2 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suite application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: ANSI/ASTM D1056; round, closed cell polyethylene foam rod; 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suite application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces and joint openings are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter which might impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with ASTM C804 for solvent release and ASTM C790 for latex base sealants.
- D. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 INSTALLATION

- A. Perform installation in accordance with ASTM C804 for solvent release and ASTM C790 for latex base sealants.
- B. Install other sealants in accordance with manufacturer's instructions.
- C. Measure joint dimensions and size materials to achieve required width/depth ratios.
- D. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.

3.4 CLEANING AND REPAIRING

- A. Clean work under provisions of Section 01 74 23.
- B. Clean adjacent soiled surfaces.
- C. Repair or replace finishes defaced by Work of this Section.

3.5 PROTECTION OF FINISHED WORK

- A. Protect finished installation under provisions of Section 01 45 17.
- B. Protect sealants until cured.

3.6 SCHEDULE

	<u>Location</u>	<u>Type</u>
A.	Door Frame/Walls	Acrylic Acoustical Sealant
C.	Under Thresholds	Butyl

D.	Ceramic Tile, Marble Thresholds	Silicone, Fungus Resistant
E.	Exposed Vertical Concrete Joints in Tilt-Up Panels and Cast-in-Place Walls	Polyurethane
F.	Exterior Windows and Doors, Perimeter	Polyurethane
G.	Glazing	Silicone
H.	Aluminum Storefront Perimeter	Silicone

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Standard hollow metal doors and frames.

1.2 RELATED SECTIONS

- A. Section 08 71 00 – Finish Hardware.
- B. Section 08 80 00 – Glazing.
- C. Section 09 90 00 – Painting and Coating: Field painting hollow metal doors and frames.
- D. Division 26 – Electrical: Electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.
- C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification:
 - 1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
 - 2. For the following items, prepared on Samples about 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:

- a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.
- E. Other Action Submittals:
 - 1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
- F. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Doors and frames shall conform to NAAMM.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C.
 - 1. Where required by agencies having jurisdiction, provide label on door and label on frame.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 3. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 250 deg F above ambient after 30 minutes of standard fire-test exposure.
- D. Pre-installation Conference: Conduct conference at Project site.
- E. Pre-installation: Mock-up doors inspected and approved by UNLV Lock Shop before commencing door and hardware work. Install one of each type of door and hardware.
- F. Pre-installation; Destructive testing of doors and frames, Owner, UNLV Lock Shop will pick a random door and frame to inspect and verify door and frame are of approved specification.

1.6 DELIVERY STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
 - 1. Provide additional protection to prevent damage to finish of factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.9 WARRANTY

- A. Provide manufacturer's one (1) year warranty under provisions of Section 01 78 36.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ceco Door Products; an Assa Abloy Group company.
 2. Curries Company; an Assa Abloy Group company.
 3. Steelcraft Manufacturing; an Ingersoll Rand company.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M-16, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M-15, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M-15, Commercial Steel (CS), Type B; with minimum A60 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M-89, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665-12, Type I Class (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

- I. Glazing: Comply with requirements in Section 08 80 00.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
1. Design: As indicated.
 2. Clearly mark doors to match Architectural opening numbers.
 3. Core Construction: Vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - b. Core shall consist of 22 gauge vertical steel stiffeners spaced 6 inches apart and securely attached to face sheets by spot welds. Spaces between stiffeners shall be sound deadened and insulated the full height of the door with an inorganic noncombustible batt type material.
 - c. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors and interior doors where indicated.
 4. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches.
 5. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
 6. Top and Bottom Edges: Closed with flush or inverted 0.042-inch thick, end closures or channels of same material as face sheets.
 7. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: 16 gauge. Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 3 and Physical Performance Level A (Maximum Duty), Model 2 (Seamless).
- C. Interior Doors: 18 gauge. Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets. Doors without proper reinforcement will not be accepted.
1. Hinges 7 gauge
 2. Locks 12 gauge
 3. Closers 12 gauge
 4. Surface hardware 16 gauge
 5. Use Riv-Nuts on existing frames without reinforcement.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile. Knock down frames are not allowed.

- B. Clearly mark frames to match architectural opening numbers.
- C. Exterior Frames: 14 gauge. Fabricated from metallic-coated steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded unless otherwise indicated.
 - 3. Frames for Level 4 Steel Doors: 0.067-inch thick steel sheet.
- D. Interior Frames: 16 gauge to 3'11" over 14gauge. Fabricated from cold-rolled steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded unless otherwise indicated.
 - 3. Frames for Level 2 Steel Doors: 0.053-inch thick steel sheet.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.
 - 1. Hinges 7 gauge
 - 2. Locks 12 gauge
 - 3. Closers 12 gauge
 - 4. Surface Hardware 14 gauge
 - 5. Continuous hinges shall have 14 gauge full height of frame face for full surface hinges.
 - 6. Continuous hinges on existing frames without reinforcement will require the use of Riv-Nuts.
 - 7. Use Riv-Nuts on existing openings without reinforcement.
 - 8. Without proper hardware reinforcements doors and frames will not be accepted.
- F. All mullions at side lights, borrowed lights and transoms shall be continually welded including the face, rabbets, stops and soffits, ground, dressed and finished. Plug weld mullion seams every 6" and finish. Continuous weld top, bottom, and faces.
 - 1. Acceptable Manufacturers:
 - a. Ceco Door Products - Series SQ
 - b. Curries Company - Series M
 - c. Steelcraft Manufacturing.
 - d. Alternate manufacturer's may be considered upon approval of samples submitted to UNLV. No other manufacturers may be submitted without prior approval of submitted sample.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 HOLLOW METAL PANELS

- A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.
- D. Terminated Stops: Where indicated on interior door frames, terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
 - 1. Provide terminated stops where indicated.

2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch wide steel.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.9 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
 - 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Frames shall be clearly labeled to correspond with architect's door schedule opening numbers.
 - 3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

4. Mullions and open back headers: Plug welded mullion seams every 6" and finish, continuous weld joint at all seams, top and bottom. Including faces, rabbets, soffits and faces. Fill and finish as required.
 5. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 6. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 7. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 8. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
 - c. Compression Type: Not less than two anchors in each jamb.
 - d. Post installed Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 9. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 08 71 00.
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.

3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.10 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory-Applied Paint Finish: Manufacturer's standard, complying with ANSI/SDI A250.3 for performance and acceptance criteria.

2.11 COLOR AND GLOSS

- A. As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
 - 9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

FLUSH WOOD DOORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Solid core doors with wood veneer, hardboard or MDF faces.
- B. Factory finishing wood doors.
- C. Factory fitting wood doors to frames and factory machining for hardware.
- D. Light frames and glazing installed in wood doors.

1.03 RELATED SECTIONS

- A. Section 08 11 13 – Hollow Metal Doors and Frames.
- B. Section 08 71 00 – Door Hardware.
- C. Section 08 81 00 – Glazing.

1.04 REFERENCES

- A. ANSI A208.1 – Wood Particleboard.
- B. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
- C. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
- D. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
- E. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
- F. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 23.
- B. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A or AWS classifications. Include factory finishing specifications.
- C. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the wood door supplier in order to prepare the doors and frames to receive the finish hardware items.

- D. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire protection ratings for fire rated doors.
- E. Samples for Initial Selection: For factory finished doors.
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
 - 2. Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide samples for each species of veneer and solid lumber required.
 - b. Finish veneer faced door samples with same materials proposed for factory finished doors.
 - 3. Frames for light openings, 6 inches long, for each material, type, and finish required.
- F. Warranty: Sample of special warranties.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors".
- C. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C (neutral pressure testing according to UL 10B where specified).
 - 1. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies provide manufacturer's construction label, indicating compliance to independent 3rd party certification agency's procedure, except for size.
 - 2. Temperature Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire test exposure.
 - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
 - 4. Blocking: Indicate size and location of blocking in 45, 60 and 90 minute mineral core doors.
- D. Pre-Submittal Conference: Conduct conference with attendance by Owner, Architect, representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing flush wood doors.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.

- B. Delivery, storage and protect products under provisions of Section 01 66 00.
- C. Package pre-finished doors individually in plastic bags or cardboard cartons and wrap bundles of doors in plastic sheeting.
- D. Mark each door on top rail with opening number used on Shop Drawings.

1.06 PROJECT CONDITIONS

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

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.
 - c. Telegraphing of core construction and delaminating of face in decorative laminate-faced doors.
 - 2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid Core Interior Doors: Life of installation according to manufacturer's written warranty.

PART 2 PRODUCTS

2.01 DOOR CONSTRUCTION – GENERAL

- A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: Premium.
- B. Fire Rated Doors: Provide construction and core as needed to provide replacement of existing fire ratings with the following parameters:
 - 1. Category A Edge Construction: Provide fire rated door edge construction with intumescent seals concealed by outer stile (Category A) at 45, 60 minute rated doors where found and replacement is indicated. Comply with specified requirements for exposed edges.
 - 2. Category B Edge Construction: Provide 20 minute fire rated doors as Category B, with smoke and fire seals (supplied by seal manufacturer) applied to frame for 20 minute door openings where found and replacement is indicated.
 - 3. Pairs: Provide fire retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - a. Where required or specified, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.

2.02 CORE CONSTRUCTION

A. Particleboard Core Doors:

1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-2.
2. Adhesive: Fully bonded construction using Polyurethane (PUR) glue.
3. Blocking: When through-bolted hardware is not used, provide wood blocking in particleboard core doors as follows:
 - a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
 - b. 5-inch (125-mm) mid-rail blocking, in doors indicated to have exit devices.
 - 1) Optional Cores for Blocking: Provide doors with either glued-wood-stave or structural-composite-lumber core instead of particleboard core for doors indicated to receive closers and exit devices.

2.03 VENEERED DOORS

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

1. Graham: GPD, VT Industries, Buell Door, Weyerhaeuser Co.
2. Substitutions: Under provisions of Section 01 25 13

B. Interior Solid Core Doors:

1. Match between Veneer Leaves: Book match.
2. Assembly of Veneer Leaves on Door Faces:
 - a. Running Match.
3. Typical Interior Door overall thickness: 1-3/4" thick.
4. Vertical Edges: Matching same species as faces. Wood or composite material, one piece, laminated, or veneered. Minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.
5. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.
7. Construction: Five plies. Stiles and rails are bonded to core, then entire unit sanded before applying face veneers.
7. At doors over 40% of the face cut-out for lights and or louvers, furnish engineered composite lumber core.

C. Door Facing and Color: Flush Interior Veneer Facing matching color of other existing doors.

2.04 LIGHT FRAMES AND GLAZING

A. Metal Frames for Light Openings in Fire Rated Doors over 20-minute rating: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating where indicated.

B. Glazing: Comply with the flush wood door manufacturer's written instructions.

FABRICATION

- A. Factory fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with requirements in NFPA 80 for fire rated doors.
- B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Where indicated, factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.
- C. Openings: Cut and trim openings through doors in factory.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
 - 3. Louvers: Factory install louvers in prepared openings.

2.06 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Finish: Provide a matching protective coating over the wood veneer painted door matching other existing wood doors installed in the project. Color is applied to the wood surface underneath the transparent finish to add/ match color and brightness.
 - 1. Grade: Premium.
 - 2. Finish: As Indicated by Architect.
 - 3. Color: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.
- C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 ADJUSTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Access door and frame units.
- B. Wall and ceiling locations.

1.2 RELATED SECTIONS

- A. Section 07 90 00 – Joint Protection: Perimeter sealant.
- B. Section 09 21 16 - Gypsum Board Assemblies: Openings in partitions.
- C. Section 09 90 00 – Painting and Coating: Field paint finish.
- D. Divisions 22 and 23: Plumbing components requiring access.
- E. Section 26 05 35 - Boxes: Electrical components requiring access.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide sizes, types, finishes, scheduled locations, and details of adjoining work.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 78 39.
- B. Record actual locations of all access units.

1.5 COORDINATION

- A. Coordinate work under provisions of Section 01 31 13.
- B. Coordinate the work with mechanical, electrical, and plumbing work requiring access units.

PART 2 PRODUCTS

2.1 MANUFACTURERS - WALL AND CEILING UNITS

- A. BAR-CO, Division of Alfab.
- B. Bilco Company.
- C. JL Industries.

- D. Karp Associates, Inc.
- E. Milcor.
- F. Acudor.
- G. Cesco.
- H. Substitutions: Under provisions of Section 01 25 00.

2.2 FLUSH FRAMED ACCESS DOORS

- A. Frames and nominal 1 inch wide exposed flanges of 16 gage steel and door panels of 14 gage steel.

2.3 FABRICATION - WALL AND CEILING UNITS

- A. Fabricate frames and doors of continuous welded construction; phosphate dipped, prime coated.
- B. Weld, fill, and grind joints to assure flush and square unit.
- C. Hardware:
 - 1. Hinge: Concealed continuous hinge with spring-type constant force closer.
 - 2. Lock: Cylinder lock with latch, two keys for each unit.

2.4 FINISHES

- A. Base Metal Protection: Phosphate dipped with rust inhibitive baked on primer.
- B. Finish: Paint to match adjacent surfaces.

2.5 SPARE MATERIALS

- A. Provide two keys for each door installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify substrate conditions are ready to receive Work of this Section.
- B. Verify that rough openings for door and frame are correctly sized and located.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in opening. Secure rigidly in place.
- C. Position unit to provide convenient access to concealed work requiring access.

- D. Caulk around perimeter flange at gypsum board surfaces.

3.3 SCHEDULE

- A. Walls to access plumbing valves or other controls: 12 inch x 12 inch. See also plumbing, mechanical, and electrical.
- B. Access doors providing access to fire dampers shall be marked as such.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

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. Mechanical and electrified door hardware for:
 - a. Swinging doors.
 - b. Sliding doors.
 - c. Gates.
- 2. Electronic access control system components, including:
 - a. Electronic access control locksets and electric strikes.
- 3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
- 4. Lead-lining door hardware items required for radiation protection at door openings.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

- 1. Windows
- 2. Cabinets (casework), including locks in cabinets
- 3. Signage
- 4. Toilet accessories
- 5. Overhead doors

C. Related Sections:

- 1. Division 01 Section "Alternates" for alternates affecting this section.
- 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
- 3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
- 4. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
- 5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
- 6. Division 28 sections for coordination with other components of electronic access control system.

1.3 REFERENCES

A. Fire/Life Safety

1. NFPA - National Fire Protection Association
 - a. NFPA 70 – National Electric Code
 - b. NFPA 80 - Standard for Fire Doors and Fire Windows
 - c. NFPA 101 - Life Safety Code
 - d. NFPA 105 - Smoke and Draft Control Door Assemblies
2. State Fire Safety Code.

B. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

C. Accessibility

1. ADA - Americans with Disabilities Act.
2. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

D. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

E. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

1.4 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

- a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Type, style, function, size, and finish of each hardware item.
 - d. Name and manufacturer of each item.
 - e. Fastenings and other pertinent information.
 - f. Location of each hardware set cross-referenced to indications on Drawings.
 - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - h. Mounting locations for hardware.
 - i. Door and frame sizes and materials.
 - j. Name and phone number for local manufacturer's representative for each product.
 - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
 - 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.
5. Key Schedule:
 - a. Key Schedule and keying to be done by UNLV Facilities Lock Shop
6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:

- a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- 3. Certificates of Compliance:
 - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
- 4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
- 5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

- 1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.
 - e. Final approved hardware schedule, edited to reflect conditions as-installed.
 - f. Final keying schedule
 - g. Copies of floor plans with keying nomenclature
 - h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE

- A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
 - 1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
 - a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
 - 2. Where products indicate "acceptable substitute" or "acceptable manufacturer", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.
- B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity,

type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
- D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 2. Can provide installation and technical data to Architect and other related subcontractors.
 3. Can inspect and verify components are in working order upon completion of installation.
 4. Capable of producing wiring diagrams.
 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

- I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
- J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
 - 2. Maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 - 4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
- K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
 - 1. Attendees: Owner, Contractor, Architect, Installer, and Supplier's Architectural Hardware Consultant.
 - 2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.
- L. Pre-installation Conference: Conduct conference at Project site
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Inspect and discuss preparatory work performed by other trades.
 - 3. Inspect and discuss electrical roughing-in for electrified door hardware.
 - 4. Review sequence of operation for each type of electrified door hardware.
 - 5. Review required testing, inspecting, and certifying procedures.
- M. Coordination Conferences:
 - 1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.

2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
 - a. Attendees: Owner's access control company – Vegas Valley Locking Systems, electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Architect and Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 1. Promptly replace products damaged during shipping.
 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys and permanent cores to: JJ Hall, Lead Locksmith, UNLV Lock Shop by registered mail or overnight package service.

1.7 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.
- F. Direct shipments not permitted, unless approved by Contractor.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
 - a. Closers:
 - 1) Mechanical: 30 years for LCN 4000
 - 2) Electrified: 2 years.
 - b. Automatic Operators: 1 year
 - c. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - d. Locksets:
 - 1) Mechanical: 7 years.
 - 2) Electrified: 1 year.
 - e. Continuous Hinges: Lifetime warranty
 - f. Key Blanks: Lifetime
 - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE

- A. Extra Materials:
 - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Door Hardware: Coordinate with UNLV Lock Shop
 - b. Electrical Parts: Coordinate with UNLV Lock Shop
- B. Maintenance Tools:
 - 1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers other than those listed shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated as "Acceptable Manufacturer" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

Item	Scheduled Manufacturer	Acceptable Manufacturer
Hinges	Ives (IVE)	Hager, Stanley
Continuous Hinges	Ives (IVE)	Markar, Stanley
Electric Power Transfer	Von Duprin (VON)	ABH,
Flush Bolt	Ives (IVE)	Hager, Rockwood
Surface Bolts	Ives (IVE)	Hager, Rockwood
Coordinators	Ives (IVE)	Hager, Rockwood
Locksets & Deadlocks	Schlage (SCH)	No Substitute
Aluminum Door Locks – Narrow Style	Medeco Keymark (MED)	No Substitute
Sliding Door Locks	Adams Rite (ADA)	As pre-approved
Pocket Door Locks	Accurate (ACC)	As pre-approved
Exit Devices & Mullions	Von Duprin (VON)	No Substitute
Electronic Access Control – Hardwired	Millennium	No Substitute
Access Control Readers	Schlage Electronics (SCE)	No Substitute
Access Control Credentials	Schlage – Electronic (SCE)	No Substitute
Electric Strikes	Schlage – Electronic (SCE)	HES
Magnetic Locks - Surface Type	HES (HES)	No Substitute
Magnetic Locks - Shear Type	Schlage Electronics (SCE)	Securitron
Cylinders & Keying	Medeco Keymark (MED)	No Substitute
Door Closers	LCN (LCN)	No Substitute
Closer/Holder Unit	LCN (LCN)	No Substitute
Electro-Mechanical Automatic Operators	Stanley (STN)	No Substitute
Protection Plates	Ives (IVE)	Hager, Rockwood
Overhead Stops	Ives (IVE)	Hager, Rockwood
Thresholds & Weatherstrip	Ives (IVE)	Pemko, Zero
Silencers	Ives (IVE)	Pemko, Zero
Magnetic Holders	LCN (LCN)	Hager, Rockwood

Latch Protector	Ives (IVE)	Hager, Rockwood
Sliding Door Hardware	Ives (IVE)	Hager, Rockwood

- D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 EXISTING MATERIALS

- A. Where existing door hardware is indicated to be removed and reinstalled:
 - 1. Carefully remove door hardware and components.
 - 2. Clean, protect and store existing door hardware in accordance with storage and handling requirements specified herein.
 - 3. Reinstall in accordance with installation requirements for new door hardware.

2.3 MATERIALS

- A. Fasteners
 - 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 - 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 - 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Modification and Preparation of Existing Doors: Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 - 1. Use materials which match materials of adjacent modified areas.
 - 2. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
 - 1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.

2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.

2.4 HINGES

A. Provide five-knuckle, ball bearing hinges.

1. Manufacturers and Products:

- a. Scheduled Manufacturer and Product: Ives 5BB series.
- b. Acceptable Manufacturers and Products: Hager BB series, Stanley FBB series, Stanley FBB Series.

B. Requirements:

1. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
2. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
3. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
5. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
7. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
8. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
10. Provide mortar guard for each electrified hinge specified, unless specified in hollow metal frame specification.

11. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.5 CONTINUOUS HINGES

A. Stainless Steel

1. Manufacturers:

- a. Scheduled Manufacturer: Ives
- b. Acceptable Manufacturers: Markar, Stanley

2. Requirements:

- a. Provide pin and barrel continuous hinges conforming to ANSI A156.26, Grade 2.
- b. Provide pin and barrel continuous hinges fabricated from 14 gauge, type 304 stainless steel.
- c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
- d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
- e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
- f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
- g. Install hinges with fasteners supplied by manufacturer.
- h. Provide hinges with symmetrical hole pattern.

B. Cold-Rolled Steel

1. Manufacturers:

- a. Scheduled Manufacturer: Ives
- b. Acceptable Manufacturers: Markar, Stanley

2. Requirements:

- a. Provide pin and barrel continuous hinges conforming to ANSI A156.26, Grade 2.
- b. Provide pin and barrel continuous hinges fabricated from type 1012 cold rolled steel.
- c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
- d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
- e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
- f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
- g. Install hinges with fasteners supplied by manufacturer.
- h. Provide hinges with symmetrical hole pattern.

C. Aluminum Geared

1. Manufacturers:
 - a. Scheduled Manufacturer: Ives.
 - b. Acceptable Manufacturers: Markar, Stanley.
2. Requirements:
 - a. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 2.
 - b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
 - c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
 - d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
 - e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 - f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
 - g. Install hinges with fasteners supplied by manufacturer.
 - h. Provide hinges with symmetrical hole pattern.

2.6 ELECTRIC POWER TRANSFER

- A. Manufacturers:
 - a. Scheduled Manufacturer: Von Duprin
 - b. Acceptable Manufacturers: ABH
- B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.
- C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.7 FLUSH BOLTS

- A. Manufacturers:
 1. Scheduled Manufacturer: Ives
 2. Acceptable Manufacturers: Hager, Rockwood
- B. Requirements:
 1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.8 SURFACE BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:

1. Surface bolts to have 1" throw for maximum security with concealed mounting that prevents vandalism. Units to be constructed of heavy duty steel and cUL listed up to three (3) hours when used on the inactive door of a pair up to 8' in height.

2.9 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

2.10 ALUMINUM DOOR LOCKS – NARROW STYLE

A. Manufacturer and Product: Adams Rite 4900 series X 4568/9 Lever or 4590/1 Paddle

B. Requirements:

1. Provide narrow style aluminum door locks as specified. Cylinders: Refer to "KEYING" article, herein.
2. Provide locks with [1-1/8 inches (29 mm)][1-1/2 inches (38 mm)] backset as required for door detail with full 5/8 inch (16 mm) throw latchbolt.
3. Provide manufacturer's standard strikes unless extended lip strikes are necessary to protect trim.

2.11 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage ND Series

B. Requirements:

1. Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1. Cylinders: Refer to "KEYING" article, herein.

2. If Required- Provide cylindrical locks with classroom security function with an inside indicator that provides clear direction for users to safely and quickly secure the room.
3. Provide locksets able to withstand 1500 inch pounds of torque applied to locked outside lever without gaining access per ANSI A156.2 Abusive Locked Lever Torque Test and cycle tested to 3 million cycles per ANSI A156.2 Cycle Test.
4. Provide solid steel rotational stops to control excessive rotation of lever.
5. Provide completely re-functionable lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.
6. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
7. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
8. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
9. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
10. Provide electrified options as scheduled in the hardware sets.
11. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
 - a. Lever Design: Schlage Rhodes.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.12 EXIT DEVICES VON DUPRIN AND/OR THE CONCEALED CABLE DEVICE

A. Manufacturer and Product: Von Duprin 99/33 series OPTION 98/35 series, No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, [OPTION for specific compliant products/applications: UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4,] and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to "KEYING" article, herein.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
3. Quiet Operation: Incorporate fluid damper or other device that eliminates noise of exit device operation.
4. Touchpad: Extend minimum of one half of door width, but not the full length of exit device rail. Provide end-cap with two-point attachment to door. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. Provide compression springs in devices, latches, and outside trims or controls; tension springs prohibited.
5. Provide rim devices with a dual cylinder or inside thumb turn cylinder option with a visual security indicator that identifies the trims locked/unlocked status of the door from the inside of the room. Indicator in unlocked state presents a 1/2 inch x 1/2 inch white metal flag with black icon at top of device head. Indicator in locked state has no flag present. Provide rim devices without the dual cylinder or inside thumb turn cylinder option capable of being retrofitted with the visual security indicator.
6. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrical requirements.
7. OPTION XP 98/99 only: Static Load Resistance, Rim Exit Devices: 2000+ lbs.
8. OPTION XP 98/99 only: Latchbolt, Rim Exit Devices: Non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress.

9. OPTION 98/9949 and/or 33/3549A only: Concealed Vertical Cable Exit Devices: Cable-actuated concealed vertical latch system in two-point and less bottom latch (LBL) configurations. Vertical rods not permitted.
 - a. Cable: Stainless steel core wire in stainless steel with polytetrafluoroethylene (Teflon®) liner color-coded to latches and center slides. Conduit and core wire ends snap into latch and center slides without use of tools.
 - b. Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper-infiltrated steel, with molybdenum disulfide low friction coating.
 - c. Top Latchbolt: Minimum 0.382 inch (10 mm) and greater than 90 degree engagement with strike to prevent door and frame separation under high static load.
 - d. Bottom Latchbolt: Minimum of 0.44 inch (11 mm) engagement with strike.
 - e. Product Cycle Life: 1,000,000 cycles.
 - f. Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
 - g. Latch release does not require separate trigger mechanism.
 - h. Cable and latching system characteristics:
 - 1) Assembled prior to being installed in door.
 - 2) Installed in door as complete assembly.
 - 3) Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
 - 4) Connected to exit device at single attachment point.
 - 5) Bottom latch height adjusted from single point, after system is installed and connected to exit device, while door is hanging
 - 6) Latch position altered up and down 2 inches (51 mm) without additional adjustment.
 - 7) System may be removed while door is hanging.
 - 8) Configure latchbolt mounting: double or single tab mount for steel doors, and wood doors, face mount for aluminum doors, eliminating requirement of tabs.
 - 9) Provide adjustable exit device to latch center line adjustment. Ensures double tab mounting option for top latch, regardless of exit device centerline.
10. Provide exit devices with manufacturer's approved strikes.
11. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
12. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
13. Provide cylinder[hex-key] dogging at non-fire-rated exit devices, unless specified less dogging.
14. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion that is removed by use of a keyed cylinder, which is self-locking when re-installed.
15. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever Style: Match lever style of locksets.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
16. Provide UL labeled fire exit hardware for fire rated openings.

17. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
18. Provide electrified options as scheduled in the hardware sets.

2.13 ACCESS CONTROL READER

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: aptiQ MT15. No substitute.

B. Requirements: Read Only Multi-technology Contactless reader

1. Access control card readers shall be as manufactured by a global company who is a recognized leader in the production of access control devices. Card reader manufactured for non-access control applications shall not be acceptable.
2. Multi-technology contactless reader shall read access control data from both 125 kHz and 13.56 MHz contactless smart cards and NFC-compatible. The multi-technology contactless reader shall be optimally designed for use in access control applications that require reading both 125 kHz Proximity and 13.56 MHz contactless smart cards by providing:
 - a. Configuration allows reader to be enabled to read smart, proximity or both technologies at the same time.
 - b. A migration platform to upgrade from the most popular 125 kHz proximity technologies to MIFARE or MIFARE DESFire EV1 by reading both 125 kHz proximity technology and 13.56 MHz contactless smart card technology.
 - c. Guaranteed compatibility to read all standard data formats ensuring card-to-reader interoperability in multi-location installations and multi-card/reader populations.
 - d. Secure access control data exchange between the smart card and the reader utilizing diversified keys and mutual authentication sequences.
 - e. Universal compatibility with most access control systems.
 - f. Ease of installation through industry standard wiring methods.
 - g. Compatibility with legacy 125 KHz proximity access control formats (all standard formats up to 37 bits, including HID Corporate 1000 formats).
 - h. Optimal read range and read speed for increased access control throughput.
 - i. Global availability.
 - j. Product construction suitable for both indoor and outdoor applications.
 - k. Customizable behavior for indicator lights and beeper.
3. Multi-technology contactless reader shall comply with the following 13.56MHz-related standards to ensure product compatibility and predictability of performance:
 - a. ISO 14443
4. Multi-technology contactless reader shall be configurable to read 13.56 MHz data simultaneously from the following cards (multiple credential support based on reader configuration):
 - a. Secure support - Mifare DESFire EV1with PACSA, Mifare Classic, FIPS 201 PIV Credential.
 - b. UID/CSN Support – DESFire Classic V0.06, HID iClass, ISOX (my-d).
 - c. Proximity – Schlage Proximity, XID Proximity, HID Prox, AWID, GE/CASI, Lenel Prox, Inside Pictotag, TI Tagit, ST Micro.

5. Multi-technology contactless reader shall be configurable to read data from any compatible 125 kHz technology simultaneously with 13.56 MHz data. Compatible 125 kHz technologies include:
 - a. XCEEDID/Schlage/HID Prox (format in the card – formats up to 37-bits supported).
 - b. AWID PROX (SAME AS LENEL PROX - format in the card – formats up to 42-bits).
 - c. GE PROX - two possible format options.
6. Multi-technology contactless reader shall provide the ability to read card access data stored in the secure access control sector/application area of the ISO 14443 XceedID MIFARE or MIFARE DESFire EV1 card.
7. The Multi-technology contactless reader shall be configurable to provide multiple hierarchical degrees of key compatibility for accessing the smart card access control data. Compatibility shall be provided for the following key structure options:
 - a. Compatibility with the default manufacture's key structure to ensure convenient off the shelf compatibility with manufacture's cards and readers.
 - b. Compatibility with custom keys managed by manufacturer which provide a site-specific, unique, protected key structure.
 - c. Compatibility with high security customer managed custom keys.
8. The Multi-technology contactless reader shall be configurable to provide compatibility with all standard Prox formats up to 37 bits (including Corporate 1000®).
9. Multi-technology contactless reader shall allow the reader firmware to be upgraded in the field without the need to remove the reader from the wall through the use of factory-provided device.
10. Multi-technology contactless reader shall be suitable for global deployment by meeting worldwide radio and safety regulatory compliance including:
 - a. FCC Certification (US)
 - b. CE (EU)
 - c. C-tick (Australia, New Zealand)
 - d. R&TTE Directive (15EU)
 - e. UL294 (US)
 - f. ULC-S319
 - g. IC (Canada)
 - h. FIPS201 / PIV I
 - i. IP65
11. Multi-technology contactless reader shall be fully compliant with Restriction of Hazardous Substances directive (RoHS) restricting the use of specific hazardous materials found in electrical and electronic products.
12. Multi-technology contactless reader shall provide universal compatibility with most access control systems by outputting card data in compliance with the SIA AC-01 Wiegand standard.
13. Multi-technology contactless reader shall allow for secure installation practices through mounting methods utilizing tamper resistant screws.
14. Multi-technology contactless reader shall provide the ability to transmit an alarm signal via and integrated optical tamper switch if an attempt is made to remove the reader from the wall. The tamper switch shall be programmable to provide a selectable action to provide a selectable action compatible with various tamper communication schemes provided by access control panel manufacturers. The selectable action shall include one of the following:
 - a. The reader open collector line changes from a high state (5V) to a low state (Ground).

- b. If utilizing OSDP Protocol reader shall report a tamper condition via RS485.
- 15. Multi-technology contactless reader shall provide the ability for mounting to standard electrical boxes through the use of universal international mounting holes.
- 16. Multi-technology contactless reader shall be provided with a full potted assembly.
- 17. Multi-technology contactless reader shall be provided with a quick connect wire harness.
- 18. The Multi-technology contactless reader shall provide customizable reader behavior options either from the factory, or defined in the field through the use of pre-configured command cards. Reader behavior programming options shall include:
 - a. LED & Audio configurations.
 - b. Ability to disable reading of specific card technologies or frequencies.
 - c. ISO 14443/15693 CSN output configuration.
 - d. Wiegand output spacing and timing.
- 19. Multi-technology contactless reader shall provide the following programmable audio/visual indication:
 - a. An audio beeper shall provide tone sequence to signify: access granted, access denied, power up, and diagnostics.
 - b. A light bar shall provide clear visual status (red/green/amber).
- 20. Multi-technology contactless reader shall be designed for low current operation to enable migration from most legacy proximity applications without the need to replace existing access control panels and/or power supplies. Contactless smart card power requirements shall be:
 - a. Operating voltage: 5 – 16 VDC, reverse voltage protected. Linear power supply recommended.
 - b. Current requirements: 160 mA DC, 195 mA PEAK @ 12 VDC
- 21. Multi-technology contactless reader shall meet the following physical specifications:
 - a. Dimensions: 5.1" x 3.25" x 0.83" (12.9 cm x 8.3 cm x 2.1 cm)
 - b. Weight: 9.6 oz. (272.15 g)
 - c. Material: UL94 Polycarbonate
 - d. Plastics: Consist of three-piece design with mounting plate, potted case and aesthetic cover.
 - e. Color: Black, Gray, Brown or Cream as approved by the project architect.
- 22. Multi-technology contactless reader shall meet the following environmental specifications:
 - a. Operating temperature: -31 to 151 degrees F (-35 to 67 degrees C)
 - b. Operating humidity: 5% to 95% relative humidity non-condensing
 - c. Weatherized design suitable to withstand harsh environments
 - 1) Certified rating of IP65
- 23. Multi-technology contactless reader cabling requirements shall be:
 - a. Cable distance: (Wiegand): 500 feet (150m)
 - b. Cable type: 5-conductor #22 AWG
 - c. Standard reader termination: 18" (0.5m) wire harness

2.14 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: SCE, HES

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary-resistant.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide fail-secure type electric strikes, unless specified otherwise.
5. Coordinate voltage and provide transformers and rectifiers for each strike as required.

2.15 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer: Medeco KeyMark.
2. Coordinate keying requirements with JJ Hall, Locksmith Lead, UNLV Lock Shop.

B. Small Format IC cylinders distributed throughout the Project as indicated.

1. Security: dual-locking cylinder with interchangeable core requiring restricted, patented keyway. Medeco Keymark

2.16 CYLINDERS OPTION: FOR EXISTING KEY SYSTEM

A. Manufacturer: Medeco

1. Scheduled Manufacturer: Keymark, No Substitute

B. Requirements: Provide cylinders/cores complying with the following requirements.

1. Cylinders/cores compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated.

C. Manufacturer-keyed permanent cylinders/cores, configured into existing keying system per "KEYING" article herein. Must coordinate keying with JJ Hall, Locksmith Lead, UNLV Lock Shop.

2.17 DOOR CLOSERS

A. Manufacturer and Product: LCN 4040XP series. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.

2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 3/4 inch (19 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.18 ELECTRO-MECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Stanley Magic Force Auto Operators

B. Requirements:

1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI A156.19.
 - a. Opening: Powered by DC motor working through reduction gears.
 - b. Closing: Spring force.
 - c. Manual, hydraulic, or chain drive closers: Not permitted.
 - d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
 - e. Cover: Aluminum.
2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
3. Provide drop plates, brackets, or adapters for arms as required to suit details.
4. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.
5. Provide key switches, with LED's, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to "KEYING" article, herein.
6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or

egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

7. Provide units with inputs for smoke evacuation doors, where specified, which allow doors to power open upon fire alarm activation and hold open indefinitely or until fire alarm is reset, presence detector input, which prevents closed door from opening or door that is fully opened from closing, hold open toggle input, which allows remote activation for indefinite hold open and close second time input is activated, vestibule inputs, which allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.19 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Hager, Rockwood.

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.20 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

- c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.21 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

- 1. Scheduled Manufacturers: Glynn-Johnson
- 2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:

- 1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
- 2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
- 3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
- 4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.22 DOOR STOPS AND HOLDERS

A. Manufacturers:

- 1. Scheduled Manufacturer: Ives.
- 2. Acceptable Manufacturers: Hager, Rockwood.

B. Provide door stops at each door leaf:

- 1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
- 2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
- 3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.23 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

- 1. Scheduled Manufacturer: National Guard Products.
- 2. Acceptable Manufacturers: Pemko, Zero.

B. Requirements:

- 1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.

2. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.24 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Hager, Rockwood.

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.25 MAGNETIC HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: LCN.
2. Acceptable Manufacturers: Rixson, Sargent.

B. Requirements:

1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordination projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Wire magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.26 LATCH PROTECTORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Hager, Rockwood.

B. Provide latch protectors of type required to function with specified lock.

2.27 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)

2. Continuous Hinges: BHMA 630 (US32D)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Where on-site modification of doors and frames is required:
 1. Remove existing hardware being replaced, tag, and store according to contract documents.
 2. Field modify and prepare existing door and frame for new hardware being installed.
 3. When modifications are exposed to view, use concealed fasteners, when possible.
 4. Prepare hardware locations in accordance with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.
- A. Existing frames and doors to be retrofitted with new hardware:
 1. Field-verify conditions and dimensions prior to ordering hardware. Fill existing hardware cut outs not being reused by the new hardware. Remove existing hardware not being reused, return to Owner unless directed otherwise.
 1. Remove existing floor closers not scheduled for reuse, fill cavities with non-shrinking concrete and finish smooth.

2. Cut and weld existing steel frames currently prepared with 2.25 inch height strikes. Cut an approximate 8 inch section from the strike jamb and weld in a reinforced section to accommodate specified hardware's strike.
3. Patch and weld flush filler pieces into existing door hardware preparations in steel doors and frames, leave surfaces smooth.
4. Glue in solid wood block fillers to fill cut outs in existing wood doors, sand surfaces smooth. Alternatively, use an approved epoxy-based wood filler product, submit product data for approval.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 1. Replace construction cores with permanent cores as indicated in keying section.
 2. . OPTION: Furnish permanent cores to Owner for installation.

- J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.
- K. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
1. Conduit, junction boxes and wire pulls.
 2. Connections to and from power supplies to electrified hardware.
 3. Connections to fire/smoke alarm system and smoke evacuation system.
 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 5. Testing and labeling wires with Architect's opening number.
- L. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- M. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
1. Configuration: Provide [one power supply for each door opening][least number of power supplies required to adequately serve doors] with electrified door hardware.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three[six] <Insert number> months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

- A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

- A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.
- B. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies and/or conflicting hardware, including missing hardware, should be brought to the attention of the architect. Corrections should be made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with appropriate additional required for proper application and functionality.

HW SET 01 - VERIFY ELECTRIC STRIKE WORKS, REPLACE IF REQUIRED
ADJUST DOOR CLOSER AND REPLACE IF REQUIRED

For use on mark/door #(s):

1

Qty		Description	Catalog Number	Finish	Mfr
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks KEYING BY OWNER	626	MED
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA	689	LCN
2	EA	BLADE STOP SPACER	4040XP-61	689	LCN
1	EA	MULTITECH READER	MT15 -SUPPLIED AND INSTALLED BY VVLS RE-USE BALANCE OF DOOR, FRAME & HARDWARE	BLK	SCE

CLEAN AND REPAIR DOOR

HW SET 02 - ADJUST DOOR CLOSER AND REPLACE IF REQUIRED
REPAIR AND PAINT DOOR

For use on mark/door #(s):

23

Qty		Description	Catalog Number	Finish	Mfr
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	THRESHOLD	546A-MSLA-10 -AS INDICATED PER PLANS	A	ZER
3	EA	SILENCER	SR64 RE-USE EXISTING DOORS, FRAMES, & HARDWARE	GRY	IVE

HW SET 03

For use on mark/door #(s):

16

35B

46

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80BDCD RHO	626	SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET 04

For use on mark/door #(s):

40B

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70BDCD RHO	626	SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET 05 - POWER SUPPLY, ELECTRIC STRIKE, DOOR CONTACT, CARD READER, AND WIRING, BY VVLS

For use on mark/door #(s):

13

17A

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	SURFACE CLOSER	4040XP RW/PA TBWMS	689	LCN
1	EA	MULTITECH READER	MT15 -SUPPLIED AND INSTALLED BY VVLS RE-USE BALANCE OF DOOR, FRAME & HARDWARE	BLK	SCE

HW SET 06 - POWER SUPPLY, ELECTRIC STRIKE, DOOR CONTACT, CARD READER, AND WIRING, BY VVLS

For use on mark/door #(s):

29A

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 06A	626	SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks KEYING BY OWNER	626	MED
1	EA	ELECTRIC STRIKE	1006 -SUPPLIED AND INSTALLED BY VVLS	626	HES
1	EA	SURFACE CLOSER	4040XP RW/PA TBWMS	689	LCN

1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	MULTITECH READER	MT15 -SUPPLIED AND INSTALLED BY VVLS	BLK	SCE

HW SET 07

For use on mark/door #(s):

45 47

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CLASSROOM LOCK	L9070BDC 06A	626	SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	GASKETING	188S-BK RE-USE BALANCE OF DOOR, FRAME & HARDWARE	S-Bk	ZER

HW SET 08 - REMOVE CLOSER

For use on mark/door #(s):

11 7 8 9

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		LOCKSET	REUSE EXISTING		
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	THRESHOLD	546A-MSLA-10	A	ZER
3	EA	SILENCER	SR64	GRY	IVE

HW SET 09

For use on mark/door #(s):

2 21 3 35A 4

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		LOCKSET	REUSE EXISTING		
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1		CLOSER	REUSE EXISTING		
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	THRESHOLD	546A-MSLA-10	A	ZER
3	EA	SILENCER	SR64	GRY	IVE

HW SET 10

For use on mark/door #(s):

15

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CLASSROOM LOCK	ND70BDCD RHO	626	SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	THRESHOLD	546A-MSLA-10 - OR PER EXISTING CONDITIONS RE-USE BALANCE OF DOOR, FRAME & HARDWARE	A	ZER

HW SET 11

For use on mark/door #(s):

10

18

19

20

40A

41

42

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80BDCD RHO	626	SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	THRESHOLD	544A-MSLA-10 RE-USE BALANCE OF DOOR, FRAME & HARDWARE	A	ZER

LIGHT SEAL

HW SET 12

For use on mark/door #(s):

12

14

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70BDCD RHO	626	SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	THRESHOLD	544A-MSLA-10	A	ZER
3	EA	SILENCER	SR64	GRY	IVE

RE-USE BALANCE OF DOOR, FRAME &
HARDWARE

HW SET 13 - REMOVE EXISTING DOORS. REPAIR THE FRAME AND COVER HINGE PREPS IN
FRAME WITH FILLER PLATES

For use on mark/door #(s):

36 6

NO HARDWARE REQUIRED

HW SET 14 - REMOVE DOOR CLOSER

For use on mark/door #(s):

39

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		LOCKSET	REUSE EXISTING		
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	THRESHOLD	544A-MSLA-10 RE-USE BALANCE OF DOOR, FRAME & HARDWARE	A	ZER

HW SET 15

For use on mark/door #(s):

34

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70BDCD RHO	626	SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	DOOR BOTTOM	365AA6	AA	ZER
1	EA	THRESHOLD	544A-MSLA-10 RE-USE BALANCE OF DOOR, FRAME & HARDWARE	A	ZER

SEAL

HW SET 16 - REMOVE DEADBOLT AND DOOR CLOSER

For use on mark/door #(s):

26

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 6" X 16"	630	IVE
1	EA	AUTO OPERATOR	MAGIC FORCE LOW ENERGY	630	STA
2	EA	ACTUATOR PKG WALL MT	8310-3860T	630	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET 17 - REMOVE DEADBOLT

For use on mark/door #(s):

27

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 6" X 16"	630	IVE
1		CLOSER	REUSE EXISTING		
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
RE-USE BALANCE OF DOOR, FRAME & HARDWARE					

HW SET 18 - POWER SUPPLY, ELECTRIC STRIKE, DOOR CONTACT, CARD READER, AND WIRING, BY VVLS

For use on mark/door #(s):

17B

Qty		Description	Catalog Number	Finish	Mfr
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	ELECTRIC STRIKE	1006 -SUPPLIED AND INSTALLED BY VVLS	626	HES
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	50A	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	MULTITECH READER	MT15 -SUPPLIED AND INSTALLED BY VVLS	BLK	SCE
RE-USE BALANCE OF DOOR, FRAME & HARDWARE					

HW SET 19 - ADJUST DOOR CLOSER AND REPLACE IF REQUIRED
REPAIR AND PAINT DOOR

For use on mark/door #(s):

25 28

Qty		Description	Catalog Number	Finish	Mfr
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1	EA	THRESHOLD	546A-MSLA-10 -AS INDICATED PER PLANS	A	ZER
3	EA	SILENCER	SR64 RE-USE EXISTING DOORS, FRAMES, & HARDWARE	GRY	IVE

HW SET 20

For use on mark/door #(s):

38

Qty		Description	Catalog Number	Finish	Mfr
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
3	EA	SILENCER	SR64 RE-USE EXISTING DOORS, FRAMES, & HARDWARE	GRY	IVE

HW SET 21

For use on mark/door #(s):

37

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	9847-EO-F-LBR	626	VON
1	EA	FIRE EXIT HARDWARE	9847-L-F-LBR-06	626	VON
1	EA	SFIC RIM CYLINDER	80-116	626	SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	MEETING STILE	328AA	AA	ZER
1	EA	THRESHOLD	544A-MSLA-10 -OR PER SILL DETAIL-- as required by code	A	ZER

HW SET 23 - DOOR BEING RELOCATED

For use on mark/door #(s):

31

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
3	EA	SILENCER	SR64	GRY	IVE
RE-USE EXISTING DOORS, FRAMES, & HARDWARE					

HW SET 24

For use on mark/door #(s):

44B

Qty		Description	Catalog Number	Finish	Mfr
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
RE-USE EXISTING DOORS, FRAMES, & HARDWARE					

HW SET 25 - GATES

For use on mark/door #(s):

43A

43B

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PADLOCK	KS11F1200		SCH
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED

HW SET 26 - ADJUST DOOR CLOSERS AND REPLACE IF REQUIRED

For use on mark/door #(s):

44A

48

Qty		Description	Catalog Number	Finish	Mfr
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
2		CLOSER	REUSE EXISTING		
1	EA	GASKETING	50A	A	ZER
2	EA	DOOR SWEEP	39A	A	ZER
	EA	THRESHOLD	REUSE EXISTING		

RE-USE BALANCE OF DOOR, FRAME &
HARDWARE

HW SET 27 - ADJUST DOOR CLOSER AND REPLACE IF REQUIRED

For use on mark/door #(s):

49

Qty		Description	Catalog Number	Finish	Mfr
1	EA	SFIC PERMANENT CORE	KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks -KEYING BY OWNER	626	MED
1		CLOSER	REUSE EXISTING		
1	EA	GASKETING	50A	A	ZER
2	EA	DOOR SWEEP	39A	A	ZER
	EA	THRESHOLD	REUSE EXISTING		
			RE-USE BALANCE OF DOOR, FRAME & HARDWARE		

Door Schedule

Qty	Door #	Scratch	HW Set	Mode	Width	Height	Thick	Door	Frame	Rating	Outside
1	1		01	PR	6' 0"	7' 0"	1 3/4"	EXST	EXST		
1	10		11	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	11		08	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	12		12	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	13		05	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	14		12	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	15		10	PR	6' 0"	7' 0"	1 3/8"	EXST	EXST		
1	16		03	SGL	4' 0"	7' 0"	1 3/4"	WD	HMF		
1	17A		05	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	17B		18	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	18		11	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	19		11	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	2		09	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	20		11	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	21		09	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	23		02	PR	6' 0"	7' 0"	1 3/4"	EXST	EXST		
1	25		19	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	26		16	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	27		17	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	28		19	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	29A		06	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	3		09	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	31		23	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	34		15	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	35A		09	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	35B		03	SGL	3' 0"	7' 0"	1 3/4"	WD	HMF		
1	36		13	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	37		21	PR	6' 0"	7' 0"	1 3/4"	HMD	HMF	RATED	
1	38		20	SGL	3' 0"	7' 0"	1 3/4"	WD	HMF		
1	39		14	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	4		09	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	40A		11	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	40B		04	SGL	3' 0"	7' 0"	1 3/4"	WD	HMF		
1	41		11	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	42		11	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	43A		25	PR	6' 0"	7' 0"	1 3/4"	GATE	EXST		
1	43B		25	PR	6' 0"	7' 0"	1 3/4"	GATE	EXST		
1	44A		26	PR	6' 0"	7' 0"	1 3/4"	EXST	EXST		

Qty	Door #	Scratch	HW Set	Mode	Width	Height	Thick	Door	Frame	Rating	Outside
1	44B		24	SGL	3' 0"	7' 0"	1 3/4"	WD	HMF		
1	45		07	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	46		03	SGL	3' 0"	7' 0"	1 3/4"	WD	HMF		
1	47		07	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	48		26	PR	6' 0"	7' 0"	1 3/4"	EXST	EXST		
1	49		27	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	6		13	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	7		08	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	8		08	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		
1	9		08	SGL	3' 0"	7' 0"	1 3/4"	EXST	EXST		

End of Section

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass and glazing for sections referencing this section for products and installation.

1.2 RELATED SECTIONS

- A. Section 07 90 00 - Joint Protection: Sealant and back-up material.
- B. Sections 08 11 13 - Hollow Metal Doors and Frames: Door lite frames.
- C. Section 08 41 13 - Aluminum Framed Entrances and Storefronts (where/when applicable).

1.3 REFERENCES

- A. ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.
- B. ASTM C1036 - Flat Glass.
- C. ASTM C1048 - Heat Treated Flat Glass.
- D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- E. ASTM E773 - Test Method for Seal Durability of Sealed Insulating Glass Units.
- F. ASTM E774 - Sealed Insulating Glass Units.
- G. ASTM E2074 - Test Method for Fire Tests of Door Assemblies.
- H. FGMA - Glazing Manual.
- I. FGMA - Sealant Manual.
- J. FS TT-S-00230 - Sealing Compounds, Synthetic-Rubber Base, Single Component, Chemically Curing.
- K. FS TT-S-01543 - Sealing Compound, Rubber Base.
- L. SIGMA - Sealed Insulated Glass Manufacturers Association.
- M. UL - Underwriters' Laboratories.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data on Glass Types Specified: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

- D. Samples: Submit two samples 12 x 12 inch in size, illustrating each glass unit. Submit two (2) additional samples of Type 3 glazing for review by Summerlin.
 - E. Manufacturer's Installation Instructions: Indicate special precautions required.
 - F. Manufacturer's Certificate: Certify that sealed insulated environmental glass, meet or exceed specified requirements.
- 1.5 QUALITY ASSURANCE
- A. Perform Work in accordance with FGMA Glazing Manual, FGMA Sealant Manual for glazing installation methods.
- 1.6 ENVIRONMENTAL REQUIREMENTS
- A. Do not install glazing when ambient temperature is less than 50 degrees F.
 - B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.
- 1.7 FIELD MEASUREMENTS
- A. Verify that field measurements are as indicated on shop drawings.
- 1.8 COORDINATION
- A. Coordinate Work under provisions of Section 01 31 13.
 - B. Coordinate the work with glazing frames, wall openings, and perimeter air and vapor seal to adjacent Work.
- 1.9 WARRANTY
- A. Provide ten (10) year manufacturer's warranty under provisions of Section 01 78 36.
 - B. Warranty: Include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.
- PART 2 PRODUCTS
- 2.1 MANUFACTURERS
- A. Float Glass:
 - 1. Guardian Industries Corporation.
 - 2. PPG.
 - 3. Pilkington.
 - 4. Saint Gobian.
 - 5. Visteon.
 - B. Float Glass Fabricators (Tempered, Non-Coated, Insulated):
 - 1. ACI.
 - 2. AFGD.
 - 3. Hehr Glass.
 - 4. Northwestern Industries.
 - 5. Oldcastle Glass.
 - C. Custom Laminated/Security Glass:
 - 1. Globe Amerada.
 - 2. Hehr Glass.
 - 3. Northwestern Industries.

4. Oldcastle Glass.
 - E. Fire Rated Safety Glass:
 1. Inter Edge Technologies.
 2. SAFTI, O'Keefe's.
 3. Technical Glass Products.
 4. Vetrotech – Saint Gobain.
 - F. Sealants:
 1. Zero/International INO.
 - G. Substitutions: Under provisions of Section 01 25 00.
- 2.2 FLAT GLASS MATERIALS (Refer to Drawings)
- A. Glass (Type 1): Clear; 1/4 inch thick minimum.
 - B. Safety Glass (Type 2): Clear; fully tempered with horizontal tempering, conforming to ANSI Z97.1; 1/4 inch thick minimum.
- 2.3 GLAZING COMPOUNDS
- A. Acrylic Sealant: FS TT-S-00230, Type II, Class A; single component; cured Shore A hardness of 15-25 color to match window frame.
 - B. Silicone Sealant: FS TT-S-01543, Class A; single component; solvent curing; capable of water immersion without loss of properties; cured Shore A hardness of 15-25 color to match window frame.
- 2.4 GLAZING ACCESSORIES
- A. Setting Blocks: Neoprene, 80 - 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
 - B. Spacer Shims: Neoprene, 50 - 60 Shore A durometer hardness, minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
 - C. Glazing Tape: Preformed silicone compound with integral resilient tube spacing device; 10 - 15 Shore A durometer hardness; coiled on release paper; black color.
 - D. Glazing Splines: Resilient polyvinyl chloride extruded shape to suit glazing channel retaining slot; black color.
 - E. Glazing Clips: Manufacturer's standard type.
- PART 3 EXECUTION
- 3.1 EXAMINATION
- A. Verify that openings for glazing are correctly sized and ready to receive glazing.
 - B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.

3.3 INTERIOR - WET/DRY METHOD (TAPE AND SEALANT)

- A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- C. Install removable stops, with spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
- E. Fill gaps between pane and applied stop with acrylic sealant to depth equal to bite on glazing, to uniform and level line.
- F. Trim protruding tape edge.

3.4 CLEANING

- A. Clean work under provisions of 01 74 23.
- B. Remove glazing materials from finish surfaces.
- C. Remove labels after work is complete.
- D. Clean glass.

3.5 PROTECTION OF FINISHED WORK

- A. Protect finished work under provisions of Section 01 45 17.
- B. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Light gage metal stud wall framing.
- B. Gypsum board.
- C. Glass mat faced gypsum tile backerboard.
- D. Cement backerboard.
- E. Taped and sanded joint treatment.
- F. Gypsum Board Primer Coat Treatment.
- G. Textured finish.
- H. Installation of acoustic insulation.

1.2 RELATED SECTIONS

- A. Section 05 40 00 - Cold Formed Metal Framing.
- B. Section 07 21 16 - Blanket Insulation: Thermal and acoustical insulation.
- C. Section 08 11 13 - Hollow Metal Doors and Frames.
- D. Section 08 31 13 - Access Doors and Frames: Metal access panels.
- E. Section 09 51 13 - Acoustical Panel Ceilings.
- F. Section 09 90 00 - Painting and Coating.
- G. Section 10 11 00 - Visual Display Surfaces.

1.3 REFERENCES

- A. ANSI A118.9 - Specifications for Cementitious Backer Units.
- B. ASTM C36 - Gypsum Wallboard.
- C. GA-252 - Fire Resistant Gypsum Sheathing.
- D. ASTM C442 - Standard Specification for Gypsum Backing Board and Coreboard.
- E. ASTM C475 - Joint Treatment Materials for Gypsum Wallboard Construction.
- F. ASTM C630 - Water Resistant Gypsum Backing Board.
- G. ASTM C645 - Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.

- H. ASTM C754 - Installation of Framing Members to Receive Screw Attached Gypsum Wallboard, Backing Board, or Water Resistant Backing Board.
- I. GA-600 - Fire Resistance Design Manual.
- J. ASTM C1002 - Steel Drilled Screws for the Application of Gypsum Board.
- K. ASTM C1178 - Glass Mat Water Resistant Gypsum Backing Panel.
- L. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.
- M. ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- N. ASTM E119 - Fire Tests of Building Construction and Materials.
- O. GA-201 - Gypsum Board for Walls and Ceilings.

1.4 SYSTEM DESCRIPTION

- A. Acoustic Attenuation for Interior Partitions: 47 STC in accordance with ASTM E90.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with GA-201, GA-216, GA-252, and GA-600.
- B. Applicator: Company specializing in gypsum board systems work with 5 years documented experience and approved by manufacturer.

1.6 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Indicate on shop drawings, special details associated with acoustic insulation and furring, abuse resistant installations, and joints at top of walls. Indicate on shop drawings the out-of-plane tolerance to be adhered to for the finished surface of gypsum board walls.
- C. Provide product data on metal framing, gypsum board, gypsum sheathing and joint tape.

PART 2 PRODUCTS

2.1 MANUFACTURERS - GYPSUM BOARD ASSEMBLY

- A. U.S. Gypsum Company.
- B. Pabco.
- C. Georgia Pacific.
- D. National Gypsum.
- E. Substitutions: Under provisions of Section 01 25 00.

2.2 MANUFACTURERS - GYPSUM DRYWALL SYSTEMS

- A. U.S. Gypsum Company.
- B. Pabco.
- C. Georgia Pacific.
- D. National Gypsum.
- E. Substitutions: Under provisions of Section 01 25 00.

2.3 MANUFACTURERS - NON-STRUCTURAL METAL FRAMING

- A. Cemco.
- B. Clark Dietrich
- C. Knorr Steel Framing Systems.
- D. Substitutions: Under provisions of Section 01 25 00.

2.4 FRAMING MATERIALS

- A. Studs and Tracks: ASTM C645; GA 216 and GA 600; galvanized sheet steel, 20 gage or 16 gage as indicated on drawings; 20 gage minimum, 'C' shape, with knurled faces.
- B. Furring, Ceiling, Framing and Accessories: As specified in Section 09 22 03.
- C. Fasteners: ASTM C1002; GA 216.

2.5 GYPSUM BOARD MATERIALS

- A. Standard Gypsum Board: ASTM C36; 1/2 and 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.
- B. Fire Rated Gypsum Board (For Repairs): ASTM C36; fire resistive type, UL rated; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.
- C. Glass Mat Faced Gypsum Board: ASTM C1178; glass mat moisture resistant coating, both sides; water resistant core, water retardant face; 5/8" thick. Denshield - manufactured by Georgia Pacific. To be installed at all wet areas, as indicated on drawings, and above all showers.

2.6 ACCESSORIES

- A. Acoustical Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
- B. Corner Beads: Metal.
- C. Edge Trim: GA 201 and GA 216; Type U exposed reveal bead.
- D. Joint Materials: ASTM C475; GA 201 and GA 216; reinforcing tape, joint compound,

adhesive and water.

- E. Fasteners: ASTM C1002; Type S12 and GA 216.
- F. Control Joints: USG Control Joint No. 093.
- G. Gypsum Board Primer: USG, Sheetrock First Coat.
- H. Textured Finish: Latex based materials.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Beginning of installation means acceptance of existing surfaces.

3.2 METAL STUD INSTALLATION

- A. Install studding in accordance with ASTM C754, GA-216 and GA-600.
- B. Metal Stud Spacing: 16 inches on center for interior partitions unless specifically noted otherwise on drawings.
- C. Refer to Drawings for indication of partitions extending to finished ceiling only and for partitions extending through the ceiling and bracing. Maintain clearance under structural building members as detailed to avoid deflection transfer to studs. Provide extended leg ceiling runners as detailed.
- D. Door Opening Framing: Install 16 gage double studs at door jambs. Weld double studs together with 2" long welds at 24" o.c., full height of double studs on both sides of studs, or use pre-engineered jamb stud as approved equal by Architect. Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.
- E. Blocking: Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet and shower accessories, door hardware and magnetic hold-opens, and all equipment.
- F. Coordinate installation of bucks, anchors, blocking, electrical and mechanical work placed in or behind partition framing.
- G. At Contractor's option, the use of Pro X Header by Brady is an acceptable product for use at headers.

3.3 ACOUSTICAL ACCESSORIES INSTALLATION

- A. Place acoustical insulation in all partitions shown on drawings to receive sound insulation tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items penetrating partitions.
- B. Install acoustical sealant at gypsum board perimeter of partitions shown on drawings to receive sound insulation. Install at side and bottom edges of partitions and at penetrations of partitions by conduit, pipe, ductwork, and rough-in boxes.

3.4 GYPSUM BOARD INSTALLATION

- A. Install gypsum board in accordance with GA 201, GA 216, GA-600, and manufacturer's instructions. Do not install moisture-resistant gypsum board on any toilet or shower room ceiling.
- B. Erect single layer standard gypsum board in most economical direction, with ends and edges occurring over framing members or metal stud blocking.
- C. Erect all types of single layer fire rated gypsum board vertically, with edges and ends occurring over framing members or metal stud blocking.
- D. Use screws when fastening gypsum board to metal furring or framing.
- E. Double Layer Applications: Secure second layer to first with adhesive and sufficient fasteners to hold in place. Fasten through first and second layer into framing members. Apply adhesive per manufacturer's instructions.
- F. Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.
- G. Place control joints consistent with lines of building spaces and as shown on the drawings.
- H. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.
- I. Install glass mat faced gypsum tile backerboard on 16 gauge metal studs in accordance with manufacturer's instructions and TCA Handbook. Method W-245.
- J. Hold gypsum board 1/4" maximum from top of slab and caulk the resulting joint.
- K. Provide perimeter relief for gypsum surfaces where a partition or furred wall abuts a structural element. Apply appropriate edge trim to the face-layer perimeter and apply sealant to close the gap.

3.5 JOINT TREATMENT

- A. At all unfinished gypsum board walls and furred surfaces above ceilings, or otherwise concealed from view, install tape embedded in one coat of joint compound with one additional coat of joint compound applied over all taped joints, corners, fastener heads, angles and other gypsum board accessories. Clean excess compound from joint. Sanding is not required at these areas.
- B. At all gypsum board walls, ceilings and furred surfaces scheduled to receive paint, install tape embedded in one coat of joint compound and apply three additional coats of joint compound over all taped joints, corners, fastener heads, angles and other gypsum board accessories. Finish as required by the paint manufacturer's installation instructions.
- C. At all gypsum board walls and furred surfaces scheduled to receive ceramic tile, install tape embedded in one coat of joint compound with no finish coats at all joints and corners, and install one coat of joint compound at all fastener heads, angles and other gypsum board accessories, per the requirements of the Tile Council of America methods scheduled for application and the tile backerboard manufacturer.
- D. Joint compound at all areas scheduled to receive finishes shall be sanded smooth and shall be free of tool marks and ridges.

- E. Feather the final joint compound coat at areas scheduled for paint finish onto adjoining surfaces so that the camber is a maximum 1/32 inch.

3.6 TEXTURE FINISH

- A. Apply Gypsum Board Primer prior to installing texture finishes materials in accordance with manufacturer's instructions.
- B. Spray apply texture finish materials.
- C. Provide light orange peel finish on all gypsum board walls scheduled for paint finish.
- D. Provide roller smooth finish on all ceilings and soffits scheduled for paint finish.

3.7 TOLERANCES

- A. Maximum Variation from True Flatness: 1/8 inch in 10 feet in any direction. Surfaces of walls must not exceed this variation within 6'-0" of floor or work may be rejected.

3.8 FINISHES

- A. Painted surfaces as specified in Drawings.

END OF SECTION

SECTION 09 24 00

PORTLAND CEMENT PLASTER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Portland cement plaster system.
- B. Metal lathing.

1.02 RELATED SECTIONS

- A. Section 07 90 00 - Joint Protection.
- B. Section 09 21 16 - Gypsum Board Assemblies.
- C. Section 09 90 00 - Painting and Coating.

1.03 REFERENCES

- A. ASTM C150 - Portland Cement.
- B. ASTM C206 - Finishing Hydrated Lime.
- C. ASTM C631 - Bonding Compounds for Interior Plastering.
- D. ASTM C847 - Metal Lath.
- E. ASTM C897 - Aggregate for Job-Mixed Portland Cement-Based Plasters.
- F. ASTM C926 - Application of Portland Cement-Based Plaster.
- G. ASTM C1063 - Installation of Lathing and Furring for Portland Cement Plaster.
- H. PCA (Portland Cement Association) - Plaster (Stucco) Manual.

1.04 QUALITY ASSURANCE

- A. Applicator: Company specializing in cement plaster work with 5 years documented experience.
- B. Apply cement plaster in accordance with ASTM C926 and PCA Plaster (Stucco) Manual.

1.05 SUBMITTALS

- A. Submit product data under provisions of Sections 01 33 00 and 01 33 23.
- B. Provide product data on plaster materials, characteristics and limitations of products specified.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply plaster when substrate or ambient air temperature is less than 50 degrees F nor more than 80 degrees F.
- B. Maintain minimum ambient temperature of 50 degrees F during and after installation of plaster.

PART 2 PRODUCTS

2.01 PLASTER BASE COAT MATERIALS

- A. Cement: ASTM C150, Normal - Type I Portland.
- B. Lime: ASTM C206, Type S.
- C. Aggregate: In accordance with ASTM C897 and PCA Plaster (Stucco) Manual.
- D. Water: Clean, fresh, potable and free of mineral or organic matter which can affect plaster.
- E. Bonding Agent: ASTM C631; type recommended for bonding cement plaster to concrete masonry surfaces; Thorobond as manufactured by Thoro Products.
- F. Plaster Mix Reinforcement: Glass fibers, 1/2 inch nominal length, alkali resistant.

2.02 PLASTER FINISH COAT MATERIALS

- A. Cement: As specified for plaster base coat, grey color.
- B. Lime: As specified for plaster base coat.
- C. Aggregate: Natural colored grey sand, as specified for plaster base coat.
- D. Water: Clean, fresh, potable and free of mineral or organic matter which can affect plaster.
- E. Finish: To match existing.

2.03 CEMENT PLASTER MIXES

- A. Mix and proportion cement plaster in accordance with ASTM C926, Type C, PCA Plaster (Stucco) Manual, manufacturer's instructions, or as following sentences indicate.
- B. Base and Brown Coat: One part cement, minimum 3-1/2 to maximum 4 parts aggregate, and minimum 15 percent to maximum 25 percent hydrated lime, glass fibers at a rate of one pound per sack of cement.
- C. Finish Coat: One part cement, 3 parts aggregate maximum, 30 percent minimum to 60 percent hydrated lime.
- D. Mix only as much plaster as can be used in one hour.
- E. Mix materials dry, to uniform color and consistency, before adding water.
- F. Protect mixtures from freezing, frost, contamination, and evaporation.
- G. Do not retemper mixes after initial set has occurred.

2.04 LATHING MATERIALS AND ACCESSORIES

- A. Acceptable Manufacturers:
 - 1. U.S. Gypsum.
 - 2. Alabama Metal Industries.
 - 3. Tree Island Industries - K Lath.
- B. Metal Lath: ASTM C847; 3/8" rib lath, 3.4 lb./sq. yd., galvanized.

- C. Corner Mesh: Formed sheet steel; minimum 26 gage thick; expanded flanges shaped to permit complete embedding in plaster; minimum 2 inch size.
- D. Strip Mesh: Expanded metal lath, minimum 26 gage thick; 2 inches wide x 24 inches long.
- E. Anchorages: Tie wire, nails, screws and other metal supports, of type and size to suit application; to rigidly secure lathing materials in place.
- F. Tie Wire: Galvanized Steel; minimum 18 gage.
- G. Finishes:
 - 1. Framing Materials: Galvanized.
 - 2. Hangers, Anchors, and Fastening Devices: Galvanized.
 - 3. Lath Materials: Galvanized.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify that surfaces and site conditions are ready to receive work. Verify that lath is flat and secured to substrate or framing, and joints and perimeter accessories are in place.
- B. Mechanical and Electrical: Verify services above ceilings and soffits have been tested and approved.
- C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

- A. Dampen masonry surfaces to reduce excessive suction.
- B. Clean surfaces of all foreign matter or bituminous materials.
- C. Apply bonding agent.

3.03 INSTALLATION - LATHING MATERIALS AND ACCESSORIES

- A. Apply metal lath taut, with long dimension perpendicular to supports.
- B. Lap ends minimum one inch. Secure end laps with tie wire where they occur between supports.
- C. Lap sides of diamond mesh lath minimum 1-1/2 inches.
- D. Attach metal lath to metal supports using tie wire at maximum 6 inches on center.
- E. Attach metal lath to exterior or moisture resistant gypsum board using gypsum board screws at 12 inches o.c.; occurring at furring channel locations.
- F. Attach metal lath to concrete or masonry using wire hair pins or hooks. Space attachment 24 inches on centers.
- G. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.
- H. Place beaded external angle with mesh at corners; fasten at outer edges only.

- I. Place base screed at termination of plaster areas; secure rigidly in place.
- J. Place strip mesh diagonally at corners of lathed openings. Secure rigidly in place.
- K. Place 4 inch wide strips of metal lath centered over junctions of dissimilar backing materials. Secure rigidly in place.
- L. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
- M. Position and install control joints.
- N. Space control joints a maximum of 10 feet apart on all cement plaster soffit work. Refer to Reflected Ceiling Plans for locations.

3.04 TOLERANCES

- A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.
- B. Maximum Variation from True Position: 1/8 inch.

3.05 PLASTERING

- A. Apply plaster in accordance with ASTM C926, and PCA Plaster (Stucco) Manual. Apply plaster coats on horizontal surfaces as required by these references for conditions of Work.
- B. Apply scratch coat to a nominal thickness of 3/8 inch, brown coat to a nominal thickness of 3/8 inch and a finish coat to a nominal thickness of 1/8 inch over metal lathed vertical surfaces.
- C. Apply brown coat to nominal thickness of 3/8 inch and finish coat to nominal thickness of 1/8 inch over masonry or concrete vertical surfaces.
- D. Moist cure scratch and brown coats twice daily. Apply brown coat following initial set of scratch coat. Moist cure brown coat 7 days following application.
- E. After curing, dampen base coat prior to applying finish coat. Repair cracking and checking with latex patching compound before finish coat.
- F. Apply finish coat 7 days after application of brown coat is finished.
- G. Avoid excessive working of surface. Delay trowelling as long as possible to avoid drawing excess fines to surface.
- H. Moist cure finish coat for minimum period of 48 hours.
- I. Clean control and expansion joints full length.
- J. Protect surfaces near the work of this section from damage or disfigurement.
- K. Cement plaster surface to be painted. Colors as shown on drawings.
- L. All cement plaster surfaces to have sand finish.

3.06 CONTROL AND CONTRACTION JOINTS

- A. After initial set, scribe contraction joints in exterior work every 3'-4" (40 inches) in both directions by cutting through 2/3 of the cement plaster depth, neatly, in straight lines.

END OF SECTION

SECTION 09 30 13

CERAMIC TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Porcelain wall tile.
- B. Porcelain floor tile and base (thinset method).
- C. Waterproof membrane for tile work.

1.02 RELATED SECTIONS

- A. Section 07 92 00 - Joint Sealants.
- B. Section 09 21 16 - Gypsum Board Assemblies.
- C. Section 10 28 00 - Toilet Accessories.
- D. Division 22 - Plumbing

1.03 REFERENCES

- A. ANSI/TCA A108.5 - Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.
- B. ANSI/TCA A118.1 - Dry-Set Portland Cement Mortar.
- C. ANSI/TCA A118.3 - Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy.
- D. ANSI/TCA A118.4 - Latex-Portland Cement Mortar.
- E. ANSI/TCA A118.10 - Load Bearing Waterproof Membrane for Ceramic Tile.
- F. ANSI/TCA A136.1 - Organic Adhesives for Installation of Ceramic Tile, Type 1 and Type 2.
- G. ANSI/TCA A137.1 - Specifications for Ceramic Tile.
- H. TCA (Tile Council of America) - Handbook for Ceramic Tile Installation, latest edition.

1.04 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 00.
- B. Submit product data indicating material specifications, characteristics, and instructions for using adhesives and grouts.
- C. Submit samples under provisions of Sections 01 33 00 and 01 33 23.

- D. Mount tile and apply grout on two 18 x 18 inch plywood panels, to indicate pattern, color variations, and grout joint size variations.
 - E. Submit manufacturer's installation instructions under provisions of Sections 01 33 00 and 01 33 23.
 - F. Submit Maintenance Data under provisions of Section 01 78 23.
 - G. Include recommended cleaning and stain removal methods, cleaning materials, and polishes and waxes.
 - H. Provide letter from manufacturer, installer, and contractor stating surface and substrate are acceptable for installation of ceramic tile floor finish.
- 1.05 QUALITY ASSURANCE
- A. Conform to ANSI/TCA A137.1
 - B. Conform to TCA Handbook for Ceramic Tile Installation. ANSI/TCA A108.1; A108.5; A108.10; and A118.1.
 - C. Maintain two (2) copies of TCA Handbook, latest edition, on site.
- 1.06 SYSTEM PERFORMANCE REQUIREMENTS (FLOORING)
- A. ASTM Conformance Requirements:
 - 1. Water Absorption: <0.5%
 - 2. Abrasive Wear: >100
 - 3. Breaking Strength: >250 lbs
 - 4. Coefficient of Friction Textured: >=0.6
 - 5. Facial Dimension Range: <1.5%
 - 6. Range of Thickness: <0.04"
 - 7. Warpage Diagonal: <0.75%
 - 8. Wedging: <1.00%
 - 9. Resistance to Freeze/Thaw Cycling: Resistant
- 1.07 QUALIFICATIONS
- A. Manufacturer: Company specializing in the manufacturing of products specified in this Section with minimum ten (10) years documented experience.
 - B. Installer: Company specializing in applying the work of this Section with minimum ten (10) years documented experience.
- 1.08 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 01 66 00.
 - B. Store and protect products under provisions of Section 01 66 00.
 - C. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.
- 1.09 ENVIRONMENTAL REQUIREMENTS

- A. Do not install adhesives in a closed, unventilated environment.
 - B. Maintain 50 degrees F during installation of mortar materials.
- 1.10 PRE-INSTALLATION CONFERENCE FOR CERAMIC TILE FLOOR AND WALL FINISH WORK
- A. Convene two weeks prior to commencing the work of this Section.
 - B. General Contractor to coordinate this conference and inform the following persons, in writing, of the requirement for their attendance:
 - 1. General Contractor's Superintendent.
 - 2. Owner's Construction Contract Representative.
 - 3. Architect's Representative.
 - 4. Tile Installation Subcontractor.
 - C. Attendees shall review all pertinent details, specifications and referenced standards. Discussion shall include scheduling of work and coordination with other trades, installation procedures as proposed by the tile installation subcontractor, availability of specified tile and grout, submittal approvals, and guarantee requirements.
 - D. Attendees shall tour areas scheduled to receive tile work of this Section to discuss the acceptability of the substrate including drain locations, any sloped substrates and readiness of surface for tile installation. Intersecting or abutting walls shall all be measured to check true 90° square angle of such walls. Any unacceptable conditions will be noted in the meeting minutes and a date will be set for a reconvening of this conference to review the remediated substrate condition.
 - E. The Architect will take minutes of this meeting and any required subsequent meetings, noting all discussion items and resolutions/conclusions. Draft copies of the minutes will be furnished to all attendees for their review and input prior to issuance of finalized meeting minutes.
- 1.11 EXTRA STOCK
- A. Provide extra quantity of ceramic tile units under provisions of Sections 01 77 00 and 01 78 43.
 - B. Provide 100 sq. ft. of each color and type of tile to Owner.
 - C. Submit chart showing manufacturer and color designation of all field and accent tiles installed.
- PART 2 PRODUCTS
- 2.01 MANUFACTURERS - TILE
- A. Emser Tile.
 - B. Dal-Tile.
 - C. Crossville Ceramics.
 - D. Arizona Tile.

- E. Cooperativa Ceramic D'imola.
 - F. Substitutions: Under provisions of Section 01 25 13.
- 2.02 TILE MATERIAL
- 1. As described per Finish Materials List per the Construction Set of Drawings.
- 2.03 MANUFACTURERS - MORTAR AND GROUT
- A. Laticrete International, Inc. – SpectraLOCK Pro Premium Grout (or approved equal);
 - B. Bostik.
 - C. Custom Building Products.
 - D. American Olean.
 - E. Mapei.
 - F. Substitutions: Under provisions of Section 01 25 13.
- 2.04 MORTAR MATERIALS
- A. Mortar Bed Materials: ANSI/TCA A118.1, Portland cement, sand, and water.
 - B. Bond Coat Materials: ANSI/TCA A118.4, Pre-mix thinset bond type, with acrylic additive.
- 2.05 GROUT MATERIALS
- A. Grout for Ceramic Tile: Epoxy type - ANSI A118.3.
 - B. Color Admixture: As described per Finish Materials List per the Construction Set of Drawings.
- 2.06 SEALANT
- A. All tile flooring and grouting shall be sealed using a water emulsion, acrylic sealer with a minimum of 18% non-evaporative solids.
- 2.07 ACCESSORIES
- A. Cleavage Membrane: 4 mil thick polyethylene film. Comply with ASTM D4397.
 - B. Waterproof Membrane: NobleSeal TS (or equal) composite sheet membrane of nonplasticized Chlorinated Polyethylene (CPE), nominal thickness of 30 mils, flexible synthetic elastomer with fabric laminated on both surfaces. Conforms to thin-bed waterproof membrane standard ANSI A118.10. Meets Heavy Duty Service requirements per ASTM C627.
 - C. Reinforcing Mesh: 2 x 2 inch size weave of 16/16 wire size; welded fabric, galvanized.
 - D. Transitions: Saw cut existing tile in a manner that a smooth transition can be made between the new tile and the existing.

2.08 MORTAR MIX AND GROUT MIX

- A. Mix and proportion pre-mix bond coat and grout materials in accordance with manufacturer's instructions. ANSI/TCA A118.4. TCA Handbook for Ceramic Tile Installation. ANSI/TCA 108.1.
- B. Mix and proportion cementitious materials for site made mortar bed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work and that substrates scheduled to receive thin set tile are flat with maximum variation of 1/8 inch in 10 feet; for full mortar bed tile, flat with maximum variation of 1/4 inch in 10 feet. Verify that intersecting walls form true 90° corners unless other angle is noted on drawings. Inform the Architect in writing of any wall surface out of square which could necessitate the cutting of tile to nonuniform width to match wall line.
- B. Beginning of installation means installer accepts condition of existing surfaces and substrate.

3.02 PREPARATION

- A. Protect surrounding work from damage or disfiguration.
- B. Vacuum clean existing substrate and damp clean.
- C. Seal substrate surface cracks with filler.
- D. Apply sealer conditioner to surfaces as recommended by adhesive manufacturer.

3.03 INSTALLATION - THINSET METHOD

- A. Wall Tile: Install thinset mortar, tile, and grout per TCA Handbook for Ceramic Tile Installation, latest edition: Handbook Numbers W202 over concrete walls; W245 over glass-mat-faced tile backerboard at plumbing chase walls and framed walls.
- B. Floor Tile: Install adhesive, tile, thresholds, waterproof membrane and grout in accordance with manufacturer's instructions and TCA Handbook; Method No. F122, latest edition.
- C. Lay tile to pattern indicated.
- D. Place edge strips at exposed tile edges at locations indicated.
- E. Form Cut and Form Fit tile tight to penetrations through tile; 1/16" Variation. Form corners and bases neatly. Align floor, base and wall joints. Where cut tiles are required due to room dimensions, locate the cut tiles at room edges or as shown on Drawings.
- F. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- G. Sound tile after setting. Replace hollow sounding units.

- H. Keep control joints free of adhesive or grout. Floor joints to be located not to exceed 10'0" on center. Apply sealant to joints.
- I. Allow tile to set for a minimum of 48 hours prior to grouting.
- J. Grout tile joints.
- K. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 CLEANING AND EXCESS GROUTING

- A. Clean work under provisions of Sections 01 74 13 and 01 74 23.
- B. Clean tile surfaces. Remove all stains, marks and the like.
- C. Remove excess grout from all tile surfaces, excessively raised or depressed grouting is unacceptable and shall be remediated, by scoring and replacing entire grout line in each direction.
- D. Clean and polish all floor drain lids, floor cleanout lids, and any other floor appurtenances.

3.06 PROTECTION

- A. Protect finished installation per manufacturers and TCA Handbook recommendations.
- B. Do not permit traffic over uncured finished floor surface. Provide kraft paper and 3/8 inch thick minimum plywood or particle board protection for all areas on which construction personnel must walk or work following curing of tile floors.

END OF SECTION

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical geometric panels.
- C. Support hangers for light fixtures.

1.2 RELATED SECTIONS

- A. Section 08 31 13 - Access Doors and Frames.
- B. Mechanical - Air Outlets and Inlets: Air diffusion devices in ceiling system.
- C. Electrical - Interior Lighting: Light fixtures in ceiling system.
- D. Fire Sprinkler System: Existing pipes and devices.
- E. Fire Alarm: Existing devices.

1.3 REFERENCES

- A. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- B. ASTM C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. FS HH-I-521 - Insulation Blankets, Thermal Mineral Fiber, for Ambient Temperatures.

1.4 SYSTEM DESCRIPTION

- A. Suspension system to rigidly secure acoustical ceiling system including integral mechanical and electrical components in a true and level plane with maximum deflection of 1/360 of its unsupported span.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacture of ceiling suspension system and ceiling tile panels with three years minimum experience.
- B. Installer: Company with three years minimum documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to International Building Code for combustibility requirements for materials.
- B. Ceiling system must be braced per IBC requirements for Seismic Category as identified in the Structural General Notes.

1.7 SUBMITTALS

- A. Provide product data on metal grid system components, and acoustic units. Indicate hanging system, lateral force bracing method, and interrelation of mechanical ductwork to grid system.
- B. Submit samples under provisions of Section 01 33 00.
- C. Submit two samples full size, illustrating material and finish of acoustic units.
- D. Submit manufacturer's installation instructions under provisions of Section 01 33 00.
- E. Submit method to be used for hanging of grid system.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Maintain uniform temperature of minimum 60 degrees F, and humidity of 20 to 40 percent prior to, during, and after installation.

1.9 SEQUENCING/SCHEDULING

- A. Schedule installation of acoustic units after interior wet work is dry.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - SUSPENSION SYSTEM

- A. Donn Products.
- B. Armstrong World Industries.
- C. Chicago Metallic Corporation.
- D. USG Interiors.
- E. Celotex Brand Ceiling Suspension Systems.
- F. Substitutions: Under provisions of Section 01 25 00.

2.2 SUSPENSION SYSTEM MATERIALS

- A. Grid: ASTM C635, intermediate duty, exposed T downward access removable T; components die cut and interlocking with hemmed edges.
- B. Accessories: Stabilizer bars, clips, splices, edge moldings, and hold down clips as required for suspended grid system.
- C. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
- D. Exposed Grid Surface Width: 15/16 inch.
- E. Acoustic Ceiling and Open Cell Grid Finish: Match existing. Provide matching touch-up paint.

- F. Support Channels and Hangers: Galvanized steel; size and type to suit application, to rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.

2.3 ACCEPTABLE MANUFACTURERS - ACOUSTIC UNITS

- A. Armstrong.
- B. Rockfon.

2.4 ACOUSTIC UNIT MATERIALS

- A. Lay-in ceiling panels matching existing at each location; Nominal sizes of existing are 12 inch x 12 inch, 24 inch x 24 inch, and 24 inch x 48 inch. Color to match existing – Paint touch-up where required.

2.5 ACOUSTIC UNIT MATERIALS (ALTERNATE)

- A. Lay-in acoustical tile to match existing 24 inch x 48 inch.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that existing conditions are ready to receive work.
- B. Verify that layout of hangers will not interfere with other work.
- C. Beginnings of installation means acceptance of existing conditions.

3.2 INSTALLATION

- A. Install system in accordance with ASTM C636 and manufacturer's installation instructions, as supplemented in this Section.
- B. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.
- C. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
- D. Install hangers. Submit method of hanging to Architect and Owner prior to installation of hangers.
- E. Hang system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Lateral Force Bracing: Splay 4 #12 gauge wires 90 degrees from each other, 45 degrees from ceiling plane maximum, 2 inches from cross runner intersection; fasten struts to main runner and roof support structure of adequate strength to resist vertical component induced by bracing wires; restraint points - 12 inches o.c. with first point 6 feet from wall. Ceiling areas of 144 square feet or less surrounded by walls which connect directly to the structure above, do not require lateral force bracing.
- G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

- H. Locate system on room axis according to Reflected Ceiling Plans.
- I. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.
- J. Do not eccentrically load system, or produce rotation of runners.
- K. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions.
- L. Form to accommodate plus or minus one inch movement. Maintain visual closure.
- M. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
- N. Install acoustic units level, in uniform plane, and free from twist, warp and dents.
- O. Install hold-down clips to retain panels tight to grid system within 20 ft of an exterior door.
- P. Install hanger wires so as to provide direct support at each corner of all light fixtures. This support shall be for the light fixture and independent of the ceiling suspension system.
- Q. Cut all extra wires at bottom of roof deck.

3.3 TOLERANCES

- A. Variation from Flat and Level Surface: 1/8 inch in 10 ft.
- B. Variation from Plumb of Grid Members Caused by Eccentric Loads: Two degrees maximum.

END OF SECTION

SECTION 09 65 19.33

RUBBER TILE FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rubber tile flooring with chemical properties for floor labs.
- B. Floor preparation for rubber tile flooring.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete.
- B. Section 09 68 13 – Carpet Tile.
- C. Section 09 65 19 – Resilient Tile Flooring.

1.03 REFERENCES

- A. ASTM E 648 – Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM E 662 – Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- C. ASTM F 710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- D. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
- E. ASTM F 1482 – Standard Guide to Wood Underlayment Products Available for Use under Resilient Flooring.
- F. ASTM C518 - Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- G. ASTM F 1859 - Standard Specification for Rubber Sheet Floor Covering Without Backing.
- H. ASTM F 2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- I. NFPA D2240 - Standard Test Method for Rubber Property – Durometer Hardness.
- J. NFPA F925 - Standard Test Method for Resistance to Chemicals of Resilient Flooring.
- K. NFPA F1344 - Standard Specification for Rubber Floor Tile.
- L. NFPA 258 - Test Method for Specific Density of Smoke Generated by Solid Materials.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Submit manufacturer's data on specified products.
- C. Samples:
 - 1. Submit four (4) samples, 12 x 12 inches (nominal) in size, illustrating color and pattern for each floor tile and base.
- D. Submit layout diagrams of each area of floor scheduled to receive flooring. Indicate patterns, joints, cut, flooring, and reference point.
- E. Submit manufacturer's installation instructions under provisions of Section 01 33 00.
- F. Provide letter from manufacturer, installer, and contractor stating surface and substrate are acceptable for installation of the specified product.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit cleaning and maintenance data under provisions of Section 01 78 23.
- B. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, and stripping.
- C. Manufacturer's representative to provide a physical maintenance training demonstration to Owner's maintenance staff.
- D. Submit cleaning and maintenance data for flooring and base products.
- E. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten (10) years documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum ten (10) years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store materials for three (3) days prior to installation in area of installation to achieve temperature stability.
- B. Maintain space for storage under temperature required by manufacturer.
- C. Protect roll materials from damage by storing on end and in original undamaged packaging until ready for use.
- D. Protect material from damage due to weather, excessive temperatures and construction operations.

1.08 EXTRA STOCK

- A. Provide 50 sq. ft. of tile flooring.

1.09 WARRANTY

- A. Provide manufacturer's Five (5) year warranty.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS – RUBBER TILE FLOORING

- A. Basis of Design: Nora Systems Inc.
- B. Other manufacturers with approved equal materials.
- C. Substitutions: Under provisions of Section 01 25 13.

2.02 RUBBER TILE FLOORING MATERIALS

- A. Rubber Floor Tile for Commercial Traffic with Chemical Resistance.
 - 1. Product Name (Basis of Design): Noraplan Sentica 3.0 mm, Article 2701 24" x 24", Thickness 0.12 inches, Color 6520 Snow Day.
 - 2. ASTM Specification: Type 1 and Grade 1 for ASTM F1344 Standard Specifications for Rubber Floor Tile.
 - 3. Material: Nora vulcanized rubber compound 913 with environmentally compatible color pigments that are free of toxic heavy metals like lead, cadmium or mercury.
 - 4. Composition: Homogeneous rubber compound with random scattered design.
 - 5. Surface: Smooth.
 - 6. Back of Tile/ Sheet/ Nosing: Double-sanded smooth.
 - 7. Squareness: Meeting requirements of ASTM F2055.
 - 8. Dimensional Stability: Meeting requirements of ASTM F2199.
 - 9. Flammability: NBSIR 78 950, 1.03 with more or equal than 0.45 watts/sq. cm for class 1 required and in compliance with NFPA 253.
 - 10. Smoke Density: Less than 450 and in compliance of NFPA 258.
 - 11. Slip Resistance: Static Coefficient of Friction, required to be equal or above 0.5 and in compliance with ASTM D2047.
 - 12. Bacteria Resistant: Resistant to bacteria, fungi and micro-organism activity and in compliance with ASTM E2180 / ASTM G21.
 - 13. VOCs: GreenGuard Gold certified for low VOC emissions, Blue Angel Certified and CA 01350 compliant.
 - 14. Latex Allergies: Compliant with ASTM D6499, Inhibition Elisa with results below detection level.
 - 15. Static Load: Compliant with ASTM F970 with residual compression of 0.003 inches with 800 lbs., Requirement: less than 0.005 inches with 250 lbs.
 - 16. Abrasion Resistance: Compliant with ASTM D3389, 1.1 lbs load on H-18 wheel with 1,000 cycles, 0.003 oz. weight loss.
 - 17. Elongation: Compliant with ASTM D412, modulus at 10% is 1,299.0 lbs per sq. inch, requirement: equal or bigger to 300 lbs. per sq. inch.
 - 18. Thermal Transmission: Per ASTM C518, R-value of 0.04.

2.05 ACCESSORIES

- A. Substrate Preparation: In compliance with ASTM F710 and the Nora Installation Guide.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces prepared to receive finishes are smooth and flat with maximum variation of 1/8 inch in 10 ft, and are ready to receive Work.
- B. Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization, or dusting. Test to ensure a moisture vapor transmission does not exceed 5 lb/1,000 sf./24 hours (ASTM F1869).
- C. Beginning of installation means acceptance of existing substrate and site conditions.

3.02 PREPARATION

- A. Remove sub-floor ridges and bumps, grind as required. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Apply, trowel, and float filler to leave a smooth, flat, hard surface.
- C. Prohibit traffic from area until filler is cured.
- D. Vacuum clean substrate.
- E. Supply a safe, climate controlled building and subfloor as detailed in the nora Installation Guide (available at www.nora.com/us).
- F. A subfloor that meets the requirements of ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring is required, or as detailed in the nora Installation Guide.
- G. An installation area that is weather tight and maintained either permanently or temporarily at ambient service temperature and humidity or 68°F ± 5° F and 50% ± 10% relative humidity, for at least 48-hours prior to, during and 72-hours after the application of the flooring is required.

3.03 INSTALLATION OF TILE FLOORING

- A. Install flooring in strict accordance with manufacturer's recommendations.
- B. Install flooring wall-to-wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the Drawings. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
- C. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets. Install tile to pattern as shown.
- D. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions.

3.04 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Have the flooring cleaned no sooner than 72-hours (unless given written permission from the nora® Technical Department) after the installation using either the nora pro clean® system or a standard method as detailed in the appropriate nora® Maintenance Guide.

3.05 PROTECTION OF INSTALLED CONSTRUCTION

- A. Prevent all traffic for a minimum of 12-hours and rolling loads for 72-hours to allow the adhesive to cure. If required, after 12-hours protect the flooring from damage during construction operations using Masonite, plywood or a similar product, ensuring first that the flooring surface is free of all debris. Lay panels so that the edges form a butt joint and tape the joint to prevent both movement and debris entrapment underneath them. Inspect immediately before covering and after removal for final acceptance..
- B. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

END OF SECTION

RESILIENT FLOORING AND BASE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Static dissipative resilient flooring.
- C. Floor preparation for resilient tile flooring.
- D. Resilient tile base.
- E. Resilient tile and base accessories.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete.
- B. Section 09 68 13 – Carpet Tile.

1.03 REFERENCES

- A. ASTM E 648 – Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM E 662 – Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- C. ASTM F 710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- D. ASTM F 1066 – Standard Specification for Vinyl Composition Tile.
- E. ASTM F 1482 – Standard Guide to Wood Underlayment Products Available for Use under Resilient Flooring.
- F. ASTM F 1861 – Standard Specification for Resilient Wall Base, Type TS, Group 1.
- G. ASTM F 1869 – Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- H. ASTM F 2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- I. NFPA 253 – Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- J. NFPA 258 – Standard Test Method for Measuring the Smoke Generated by Solid Materials.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Submit manufacturer's data on specified products.
- C. Samples:
 - 1. Submit four (4) samples, 12 x 12 inches (nominal) in size, illustrating color and pattern for each floor tile and base.
 - 2. Submit four (4) samples of base material for each color specified, 6" in length.
- D. Submit layout diagrams of each area of floor scheduled to receive flooring. Indicate patterns, joints, cut, flooring, and reference point.
- E. Submit manufacturer's installation instructions under provisions of Section 01 33 00.
- F. Provide letter from manufacturer, installer, and contractor stating surface and substrate are acceptable for installation of the specified product.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit cleaning and maintenance data under provisions of Section 01 78 23.
- B. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- C. Manufacturer's representative to provide a physical maintenance training demonstration to Owner's maintenance staff.
- D. Submit cleaning and maintenance data for flooring and base products.
- E. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten (10) years documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum ten (10) years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store materials for three (3) days prior to installation in area of installation to achieve temperature stability.
- B. Maintain ambient temperature as required by manufacturer.
- C. Protect roll materials from damage by storing on end and in original undamaged packaging until ready for use.
- D. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

- 1.08 EXTRA STOCK
- A. Provide 50 sq. ft. of each color of tile flooring and 50 lineal feet of base.
 - B. Submit chart showing manufacturer and color designation of all field and accent tiles installed.
- 1.09 WARRANTY
- A. Provide manufacturer's fifteen (15) year warranty.
- PART 2 PRODUCTS
- 2.01 ACCEPTABLE MANUFACTURERS – RESILIENT TILE FLOORING
- A. Johnsonite.
 - B. Centiva.
 - C. Parterre Flooring Systems.
 - D. Substitutions: Under provisions of Section 01 25 13.
- 2.02 ACCEPTABLE MANUFACTURERS – RESILIENT BASE
- A. Johnsonite.
 - B. Roppe.
 - C. Allstate.
 - D. Burke.
 - E. Substitutions: None
- 2.03 RESILIENT TILE FLOORING MATERIALS
- A. 1. Resilient Tile Flooring (VCT-1) Basis of Design: Johnsonite Model Azrock Collection Textile 12" x 24", Thickness 0.08 inches, Color V-280 Raw Silk.
2. Resilient Tile Flooring (VCT-2) Basis of Design: For Patching of existing: match color, size and brand.
 - B. Resilient Dissipative Tile Flooring (SDT-1) Basis of Design: Roppe Model ESD Static Disipative Vynil 24" x 24", Thickness 0.08, Color 701 Neutron Gray
- 2.04 RESILIENT BASE MATERIALS
- A. Resilient Base (RB-1): Johnsonite; standard toe; 4"; color 48 Grey WG.
- 2.05 ACCESSORIES
- A. Subfloor Filler: Cementitious, non-shrinking latex fortified hydraulic cement patching compound recommended by flooring material manufacturer.

- B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
- C. Conductive Adhesive: Recommended Conductive Adhesive by flooring manufacturer.
- D. Grounding Strips: Recommended Grounding Strips by flooring manufacturer.
- E. Sealer and Wax: Types recommended by flooring manufacturer.
- F. Moldings, Edge Strips, Transitions and Reducers: Same material and color as resilient base.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces prepared to receive finishes are smooth and flat with maximum variation of 1/8 inch in 10 ft, and are ready to receive Work.
- B. Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization, or dusting. Test to ensure a moisture vapor transmission does not exceed 5 lb/1,000 sf./24 hours (ASTM F1869).
- C. Beginning of installation means acceptance of existing substrate and site conditions.

3.02 PREPARATION

- A. Remove sub-floor ridges and bumps, grind as required. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Apply, trowel, and float filler to leave a smooth, flat, hard surface.
- C. Prohibit traffic from area until filler is cured.
- D. Vacuum clean substrate.
- E. Apply primer to surfaces.

3.03 INSTALLATION OF TILE FLOORING

- A. Install flooring in strict accordance with manufacturer's recommendations.
- B. Install flooring wall-to-wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the Drawings. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
- C. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets. Install tile to pattern as shown.
- D. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times. Spread only enough adhesive to permit installation of materials before initial set.

3.04 INSTALLATION OF STATIC DISSIPATIVE FLOORING

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

- B. Install with manufacturer's adhesive specified for the site conditions and follow adhesive label for proper use.
- C. Roll the flooring in both directions using a 100-pound three-section roller.

3.05 INSTALLATION OF BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 24 inches between joints.
- B. At external corners, use pre-molded units cut to fit. At exposed ends, use pre-molded units. Miter internal corners.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.
- E. Install transitions and reducers of solid shape appropriate for application.
- F. Install toeless base at carpet flooring.

3.06 INSTALLATION OF ACCESSORIES

- A. Apply top-set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
- B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cover cap on masonry surfaces or other similar irregular substrates.
- C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

3.07 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean, seal, and maintain resilient flooring products.

3.08 PROTECTION OF INSTALLED CONSTRUCTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.
- B. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

3.09 FLOOR SURFACE TREATMENT

- A. All resilient flooring surfaces on which pedestrians can walk shall be finished such that the minimum static coefficient of friction between the surface and normal hard soled shoes in strict accordance with ADA Guidelines, latest edition.

END OF SECTION

SECTION 09 68 13

CARPET TILE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet Tile and installation.
- b. Floor preparation for carpet tile.

1.02 RELATED SECTIONS

- A. Section 09 65 19 - Resilient Flooring and Base.

1.03 SUBMITTALS

- A. Shop Drawing showing columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required as well as direction of carpet pile and pattern, location of edge moldings and edge bindings shall be submitted to the Architect for approval prior to installation.
- B. Carpet schedule using same room designations indicated on drawings.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics, sizes, patterns, colors available, and method of installation.
- D. Verification Samples: Submit two 12" x 12" samples illustrating color, pattern, and backing for each carpet material specified.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include maintenance procedures, recommendations for maintenance materials and equipment, and suggested schedule for cleaning.
- G. Manufacturer's Carpet Warranty.
- H. Certifications: Manufacturer to submit copies of the following independent laboratory reports showing compliance with requirements per these methods outlined in Part 2 of this document. Submitted results shall represent average results for production goods of the specified style.
 - 1. Pill Test / DOC-FF-1-70 (ASTM D-2589) – Requirement: Pass.
 - 2. Flooring Radiant Panel / ASTM E-648- Requirement: Class I (Above .45 w/cm).
 - 3. CRI VOC Chamber Test/Indoor Air Quality test (CRI-IAQ) Green Label Plus Test.
 - 4. Lightfastness: Rating of not less than 5 on International Grey Scale after 40 SFU's when tested in accordance with AATCC Test Method 16E.
 - 5. Crockfastness: Minimum stain rating on International Grey Scale of not less than 5 wet or dry when tested in accordance with AATCC Test Method 165.
 - 6. Atmospheric Fading: Burned Gas shall not be less than 5 on International Grey Scale after two cycles on each test as per AATCC Test Method 129 Ozone and AATCC Test Method 23.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. The maximum amount of moisture evacuation from the floor is 3.0 pounds per 1,000 S.F. in 24 hours. The acceptable pH level of the substrate is between 7.0 and 9.0. Flooring contractor is responsible for floor testing.

- B. All material used in sub-floor preparation and repair shall be recommended by the carpet manufacturer and shall be chemically and physically compatible with the carpet system being bid.
- C. Maintain minimum 65 degrees F ambient temperature and maximum 65% Relative Humidity for 48 hours prior to, during, and 48 hours after installation.
- D. Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.
- E. New concrete must be clean, dry and cured for a minimum of sixty (60) days and free of parting agents. Floors must be sealed.

1.05 EXTRA MATERIALS

- A. Provide additional 5% of each type, color, and pattern furnished; product to be boxed and, when necessary, palletized. Coordinate storage location with Owner.

1.06 WARRANTY

- A. Provide manufacturer's lifetime warranty against excessive surface wear. Excessive wear means no more than 10% loss of pile fiber weight measured before and after use as tested under ASTM D-3936.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Company specializing in manufacturing specified carpet with minimum 10 years documented experience.
 - 2. Upon request, manufacturer to provide representative to assist in project start-up and to inspect installation while in process and upon completion. Representative will notify designated contact if any installation instructions are not followed.
- B. Installer Qualifications:
 - 1. Flooring contractor must be certified by the carpet manufacturer prior to bid.
 - 2. Flooring contractor to be a specialty contractor normally engaged in this type of work and shall have prior experience in the installation of these types of materials.

1.08 DELIVERY, STORAGE, & HANDLING

- A. Deliver materials to the site in manufacturer's original packaging listing manufacturer's name, product name, identification number, and related information.
- B. Store in a dry location, between 60 degrees F and 80 degrees F and a relative humidity below 65%. Protect from damage and soiling. Store in pallet form as supplied by Manufacturer. Do not stack pallets.
- C. Make stored materials available for inspection by the Owner's representative.
- D. Store materials in area of installation for minimum period of 48 hours prior to installation.
- E. Store in accordance with manufacturer's requirements.

1.09 PROJECT CONDITIONS

- A. Sub-floor preparation is to include all required work to prepare the existing floor for installation of the product as specified in this document and Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. J & J Flooring Group.
- B. Mohawk.
- C. Shaw Contract Group.
- D. Substitutions: Under provisions of Section 01 25 13.

2.02 CARPET TILE

- A. Basis of Design: Shaw disperse 24" x 24" collection Diffuse and Disperse. Construction with multi-level pattern loop, fiber eco solution nylon 6 with 100% solution dyed method. Tufted weight of 16, 9.0 stitches per inch. Primary backing to be synthetic polyolefin composite. Surface treatments with non C8 fluorocarbon chemistry. Recycled content by weight equal to 41 per cent or better with Pre-consumer recycled of 28 per cent and post-consumer recycle of 13 per cent.

2.03 ADHESIVES

- A. As recommended by the carpet manufacturer for areas with new construction subgrade leveled flooring.
- B. For installation over existing resilient flooring, Basis of Design: LokDots adhesive rolls and handheld applicator in accordance with Lok-Dots by Shaw, application style number: Shaw Contract Group 00LDA Patcraft 03LDA Phily Queen 01LDA. Pressure sensitive odor free carpet tile installation system material. Apply a minimum of 15 dots per 24 x 24 inch tile. At cut tile apply dots to perimeter of cut tile.

2.04 ACCESSORIES

- A. Materials recommended by manufacturer for patching leveling, priming, etc.
- B. Transition and edge strips as indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor is smooth and flat within specified tolerances and ready to receive carpet.
- B. Verify that substrate surface is dust-free and free of substances that would impair bonding of product to the floor.
- C. Verify that concrete surfaces are ready for installation by conducting moisture and pH testing. Results must be within limits recommended by Manufacturer.

- D. There will be no exceptions to the provisions stated in the Manufacturer's installation instructions.
- E. Verify that raised access floor panels are smooth, level, secure and free of any material that will affect the adhesive bond. Carpet modules must be offset from access panel seams. Gaps between panels must not exceed 1/16".

3.02 PREPARATION

- A. Prepare sub-floor to comply with criteria established in manufacturer's installation instructions. Use only preparation materials that are acceptable to the manufacturer.
 - 1. Remove all deleterious substances from substrate(s) that would interfere with or be harmful to the installation.
 - 2. Remove sub-floor ridges and bumps. Fill cracks, joints, holes, and other defects with a compatible latex patching compound.

3.02 INSTALLATION

- A. Install product in accordance with manufacturer's installation instructions.
- B. Where demountable partitions or other items are indicated for installation on top of finished carpet tile floor, install carpet tile before installation of these items.
- C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.
- D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- E. Roll with a 75 lb. roller for complete contact of carpet with mill-applied adhesive to sub-floor. Carpet to be securely adhered in accordance with ADA requirements.
- F. Trim carpet neatly at walls and around interruptions.
- G. Completed carpet is to be smooth and free of bubbles, puckers, and other defects.

3.04 PROTECTION

- A. Use plywood over the carpet when heavy objects are moved within 24 hours after installation.
- B. A non-staining building material paper must be placed over the carpet to protect it when additional construction activity is to take place.

3.05 CLEANING

- A. Remove excess adhesive and/or other from floor and wall surfaces without damage.
- B. All rubbish, wrappings, debris, trimmings, etc. to be removed from site and disposed of properly.
- C. Clean and vacuum carpet surfaces using a beater brush/bar commercial vacuum.
- D. After each area of carpet is installed, protect from soiling and damage by other trades.

END OF SECTION

SECTION 09 77 10

FABRIC-WRAPPED ACOUSTIC WALL PANEL

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Acoustic wall panel.

1.2 RELATED WORK

- A. Section 09 21 16 - Gypsum Board Assemblies: Wall substrate.
- B. Section 09 90 00 - Painting and Coating: Priming of substrate surfaces.

1.3 REFERENCES

- A. ANSI/ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- B. FS CCC-W-408 - Wall Covering, Vinyl Coated.
- C. FS L-P-1040 - Plastic Sheets and Strips, Polyvinylfluoride.
- D. NFPA 255 - Test of Surface Burning Characteristics of Building Materials.
- E. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing acoustic wall panel with three years documented experience.
- B. Applicator: Company specializing in installing wall panels with three years documented experience and approved by wall covering manufacturer.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame/fuel/smoke ratings of 25/35/50 when tested to ANSI/ASTM E84, NFPA 255, and UL 723.

1.6 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 23.
- B. Provide product data on wallcovering and installation requirements.
- C. Submit samples under provisions of Sections 01 33 00 and 01 33 23.
- D. Submit two samples of acoustic wall panel, 8 x 8 inch in size, illustrating color, finish, and texture.
- E. Submit manufacturer's installation instructions under provisions of Sections 01 33 00 and 01 33 23.
- F. Submit manufacturer's certificate under provisions of Section 01 78 39, and individual specification sections, that products meet or exceed specified requirements.
- G. Submit test reports verifying flame/fuel/smoke ratings, when tested by UL and an agency

approved by authority having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01 45 17.
- B. Store and protect products under provisions of Section 01 45 17.
- C. Inspect roll materials on site to verify acceptance.
- D. Protect packaged adhesive from temperature cycling and cold temperatures.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 60 degrees F, unless required otherwise by manufacturer's instructions.
- B. Package and label each panel by destination room number, store where directed.

PART 2 PRODUCTS

2.1 MANUFACTURERS - ACOUSTIC WALL PANELS

- A. MPC, Inc.
- B. Wall Technology Inc.
- C. Conwed.
- D. Decoustics.
- E. Lamvin, Inc.
- F. Tectum.
- G. Quiet Technology Systems.
- H. Sound Seal.
- I. Substitutions: Under provisions of Section 01 25 00.

2.2 ADDITIONAL MANUFACTURERS - TACKABLE ACOUSTIC WALL PANELS

- A. Armstrong World Industries, Inc.
- B. Sound Concepts Canada, Inc.
- C. Sound Stop Tackable Wall Panels.
- D. Wall Technology, Inc. – TK125WP-C.
- E. Substitutions: Under provisions of Section 01 25 00.

2.3 MATERIALS - WALL PANELS

- A. Panel Covering: Guilford Industries. Color – See Finish Materials List on drawings.
- B. Core: 7 lb./c.f. fiberglass.

- C. Vinyl Corners: Heat sealed, fully tailored.
- D. Frame: Standard with manufacturer.
- E. Mounting: TBD
- F. Dimensions: 1-1/8 inch thick; width and heights per interior elevations.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that substrate surfaces are painted and ready to receive work.
- B. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 INSTALLATION

- A. Mount panels in accordance with manufacturer's instructions.
- B. Coordinate panel installation with the locations of any fire alarm system devices, motion detectors, exit signs or other electrical devices and with the location of any HVAC grilles in the areas shown to receive panels, to avoid interfering with the function of these items. Install panels fabricated as required to be clear of such devices where conflicts may exist.
- C. Install termination trim.
- D. Install continuous bead of clear caulking at all panel edges to wall, creating a continuous perimeter seal to wall.

3.3 CLEANING

- A. Clean panels of dust, dirt, and other contaminants under provisions of Sections 00 74 13 and 00 74 23.
- B. Touch-up minor finish imperfection per manufacturer's recommendation.
- C. Remove and replace work which cannot be successfully cleaned or repaired.

3.4 PROTECTION

- A. Protect finished installation from any soiling or damage.

END OF SECTION

SOUND-ABSORBING CEILING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fixed Sound-Absorbing Panels.

1.2 SYSTEM DESCRIPTION

- A. Noise Reduction Coefficient (NRC): Minimum 75 when tested in accordance with ASTM C423.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate layout, dimensions, and finish of acoustical wall panels, frame profiles, and core materials.
 - 2. Indicate interface with adjacent materials.
- B. Product Data: Submit data on core material and accessory materials.
- C. Samples: Submit three 8 inch x 10 inch samples of each component illustrating construction, profile and surface texture and finish.
- D. Manufacturer's Installation Instructions:
 - 1. Submit manufacturers written installation instructions.
 - 2. Submit special procedures, and perimeter conditions requiring special attention.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit panel care and maintenance procedures, recommended maintenance materials, suggested schedule for cleaning, recommended procedures for removal of stains, and warranty.

1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics:
 - 1. Comply with:
 - a. Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install acoustical wall treatment until space has been enclosed and is watertight, wet work is complete and dry and adjacent and related work is completed.
- B. Do not install acoustical unit until ambient temperature and humidity level will be continuously maintained at conditions indicated for Owner occupancy and per manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MANUFACTURERS - ACOUSTIC CEILING UNITS

- A. Tectum, Inc., Finale Panel.
- B. Substitutions: Under provisions of Section 01 25 00.

2.2 MATERIAL

- A. Material:
 - 1. Aspen wood fibers bonded with inorganic hydraulic cement.
 - 2. Panels: 47 3/4 inches wide x 120 inches long maximum, beveled edges.
 - 3. Thickness: 1 inch baseboard and 1 inch Tectum furring with SoniCor fiber core between the furring, 2 inches total.
 - 4. Noise Reduction Coefficient (NRC): Minimum 0.75.
 - 5. Color: Refer to Finish Materials List in Section 09 60 00.
 - 6. Interior Composite Wood and Agrifiber Products: Contain no added urea-formaldehyde resins.
 - 7. Fire Retardant Treatment: AWPA C20 for lumber and AWPA C27 for plywood.

2.3 ACCESSORIES

- A. Fasteners: Type recommended and provided by panel manufacturer to suit application.
- B. Adhesive: Type recommended by panel manufacturer.
 - 1. Interior Adhesives: Do not exceed maximum allowable volatile organic compound content in accordance with SCAQMD Rule 1168.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify substrate is flat, dry, plumb and level and ready to receive the work of this section.
- B. Verify adjacent and related work is complete.

3.2 INSTALLATION

- A. Secure panels as recommended by manufacturer. Apply adhesive where recommended by manufacturer.
- B. All fastening devices shall be painted to match ceiling panel in complete installation.
- C. Prior to final inspection, review installation with Architect and replace all unsatisfactory panels.

3.3 ERECTION TOLERANCES

- A. Maximum Variation From Indicated Position: 1/4 inch.
- B. Maximum Offset From Indicated Alignment: 1/16 inch.
- C. Maximum Out of Square: 1/4 inch difference in panel diagonals.

3.4 SCHEDULES

- A. Refer to drawings and Finish Materials List.

3.5 CLEANING

- A. Clean panels of dust, dirt, and other contaminants under provisions of Sections 00 74 13 and 00 74 23.
- B. Touch-up minor finish imperfection per manufacturer's recommendation.
- C. Remove and replace work which cannot be successfully cleaned or repaired.

3.4 PROTECTION

- A. Protect finished installation from any soiling or damage.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation and field application of paints and coatings.

1.2 RELATED SECTIONS

- A. Section 07 84 00 – Firestopping.
- B. Section 08 41 13 – Aluminum Framed Entrances and Storefronts.
- C. Section 09 21 16 – Gypsum Board Assemblies.
- D. Section 22 05 53 – Mechanical Identification.
- E. Section 26 05 53 – Electrical Identification.

1.3 REFERENCES

- A. ANSI/ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. ASTM D2016 - Test Method for Moisture Content of Wood.

1.4 DEFINITIONS

- A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

1.5 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with three years experience.
- B. Applicator: Company specializing in commercial painting and finishing with three years documented experience.
- C. Dry film thickness shall be as scheduled and will be tested for compliance. Areas failing test for thickness will be remediated as directed by Owner or Owner's representative at Contractor's expense.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.

1.7 TESTS

- A. Provide analysis and testing of coating finish under provisions of Section 01 43 26.
- B. Dry Film Thickness Testing will be conducted by Owner or Owner's Representative at their discretion.

1.8 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 23.

- B. Provide product data on all finishing products and special coating.
- C. Submit samples under provisions of Section 01 33 23.
- D. Submit two samples, 4 x 6 inch minimum in size, illustrating range of colors and textures available for each color of surface finishing product scheduled.
- E. Submit manufacturer's application instructions under provisions of Section 01 33 23.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01 45 17.
- B. Store and protect products under provisions of Section 01 45 17.
- C. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.
- D. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- E. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
- F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
- F. Paints containing mercury compounds are not allowed on Clark County School District projects.

1.11 EXTRA STOCK

- A. Provide five gallons (one container) of each color and surface texture to Owner.
- B. Label each container with color, texture, room locations, in addition to the manufacturer's label.
- C. Provide chart showing manufacturer, color and mixing formula of all colors of paint and stain installed.
- D. Provide one (1) set of "draw down" samples to match requirements of paragraph 1.8 D

above.

PART 2 PRODUCTS

2.1 MANUFACTURERS - PAINT

- A. Dunn Edwards Paints.
- B. PPG.
- C. Sherwin Williams.
- D. Vista Paint.
- E. Substitutions: Under provisions of Section 01 25 13.

2.2 MANUFACTURERS - PRIMER AND STAIN

- A. USG – Sheetrock First Coat.
- B. Substitutions: Under provisions of Section 01 25 13.

2.3 MATERIALS

- A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
- B. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.
- C. Paint Formulation Standards:
 - 1. Interior or exterior acrylic enamel, semi-gloss:
 - a. Solids by volume - 30% minimum.
 - b. Acrylic resins by weight - 20% minimum.
 - c. Titanium Dioxide pigment by weight - 15% minimum.
 - d. Dry Heat Resistance - 250E F for non-galvanized and 150E F for galvanized exterior metal surfaces.
 - 2. Interior acrylic enamel, gloss:
 - a. Solids by volume - 30% minimum.
 - b. Acrylic resins by weight - 25% minimum.
 - c. Titanium Dioxide pigment by weight - 15% minimum.
 - 3. Interior or exterior alkyd enamel, semi-gloss:
 - a. Solids by volume - 50% minimum.
 - b. Alkyd resins by weight - 30% minimum.
 - c. Titanium Dioxide pigment by weight - 15% minimum.
 - d. Dry Heat Resistance - 250E F for non-galvanized and 150E F for galvanized exterior metal surfaces.
- D. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- E. Gloss Range: Comply with ATSM D523 for gloss range. Refer to paragraphs 3.7 and 3.8 for applicable gloss level.
 - Gloss to be as follows:
 - Flat: 15% measured at 85 degree meter.
 - Eggshell: 5% to 20% measure at 60 degree meter.
 - Satin: 15% to 35% measured at 60 degree meter.
 - Semi Gloss: 30% to 65% measured at 60 degree meter.
 - Gloss: Over 65% measured at 60 degree meter.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Located Wood: 15 percent, measured in accordance with ASTM D2016.
- D. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 PREPARATION

- A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
- B. Correct minor defects and clean surfaces which affect work of this Section.
- C. Shellac and seal marks which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
- G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- H. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- I. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.
- J. Galvanized Surfaces: Remove surface contamination and oils and wash with non-oil based solvent. Wipe clean. Apply coat of etching primer. Do not allow any oil or grease residue to remain on the metal surface.
- K. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- L. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- M. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy

coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with non-oil based solvent. Wipe clean. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

- N. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with non-oil based solvent. Touch-up bare steel surfaces with matching primer. Roughen all glossy surfaces to receive finish coats.
- O. Interior Wood Items Scheduled to Receive Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- P. Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3

PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.4

APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand lightly between coats to achieve required finish.
- F. Allow applied coat to dry per paint manufacturer's instructions before next coat is applied.
- G. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- H. Prime back surfaces of interior and exterior woodwork with primer paint.
- I. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.
- J. At completion of painting application, a dry film thickness test shall be conducted by the Owner's Representative on selected areas to establish correct paint thickness. Areas failing such testing shall be remediated at Contractor's expense.

3.5

FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Divisions 22 and 26 for schedule of color coding and identification banding of equipment, ductwork, piping, and conduit.
- B. Paint shop primed equipment.

- C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately, except where items are prefinished.
- D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, and mechanical equipment.
- E. Replace identification markings on mechanical or electrical equipment when painted accidentally.
- F. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convactor and baseboard cabinets to match face panels.
- G. Paint exposed conduit and electrical equipment occurring in finished areas.
- H. Paint both sides and edges of fire-retardant-treated plywood backboards for electrical and telephone equipment before installing equipment. The fire-rated stamp must be visible, do not paint over.
- I. Color code equipment, piping, conduit, and exposed ductwork in accordance with color schedule.
- J. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

3.6 CLEANING

- A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.7 SCHEDULE - INTERIOR SURFACES (DFT= Dry Film Thickness)

- A. Cement Plaster
 - 1. One coat 100% acrylic primer.
- B. Steel - Unprimed
 - 1. One coat 100% acrylic rust inhibitive metal primer, 1.25 mils DFT.
 - 2. Two coats 100% acrylic enamel, semi-gloss, 3.5 mils DFT.
- C. Steel - Primed
 - 1. Touch-up with 100% acrylic rust inhibitive metal primer, 1.25 mils DFT.
 - 2. Two coats 100% acrylic enamel, semi-gloss, 3.5 mils DFT.
- D. Steel - Galvanized
 - 1. One coat alkyd galvanized or non-ferrous metals primer, 1.3 mils DFT.
 - 2. Two coats 100% acrylic enamel, semi-gloss, 3.5 mils DFT.
- E. Concrete tilt-Up Panels
 - 1. One coat acrylic primer/sealer/stain killer, 1.5 mils DFT.
 - 2. Two coats elastomeric smooth texture coatings, 12.0 mils DFT.

- F. Wood - Painted
 - 1. One 100% acrylic latex primer sealer, flat, 1.25 mils DFT.
 - 2. Two coats 100% acrylic non-blocking enamel, semi-gloss, 3.5 mils DFT.
 - G. Wood - Transparent Finish
 - 1. Filler coat (for open grained wood only).
 - 2. One coat alkyd stain.
 - 3. One coat interior wood sanding sealer, vinyl copolymer type.
 - 4. Two coats polyurethane varnish, non-yellowing.
 - H. Gypsum Board - in Dry Areas
 - 1. One coat 100% acrylic latex enamel primer, 1.2 mils DFT.
 - 2. Two coats 100% acrylic enamel, 2.8 mils DFT:
 - a. Walls - semi-gloss.
 - b. Soffits and ceilings - semi-gloss.
 - I. Gypsum Board - in Wet Areas
 - 1. One coat 100% acrylic enamel primer, 1.2 mils DFT.
 - 2. Two coats 100% acrylic enamel: 2.8 mils DFT.
 - a. Walls - semi-gloss.
 - b. Soffits and Ceilings – semi-gloss.
 - J. Concrete - in Wet Areas
 - 1. Two coats block filler, 12.0 mils DFT.
 - 2. Two coats 100% acrylic enamel, gloss, 2.0 mils DFT.
 - K. Concrete - Dry Areas
 - 1. Two coats block filler, 12.0 mils DFT.
 - 2. Two coats 100% acrylic enamel, semi-gloss, 2.0 mils DFT.
 - L. Concrete - Sealed
 - 1. Sealer - per manufacturer's recommendations.
- 3.8 SCHEDULE - SURFACE FINISH AND COLORS
- A. See Finish Materials List on drawings.

END OF SECTION

SECTION 10 11 00

VISUAL DISPLAY SURFACES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surfaced metal markerboards.
- B. Tackboards.
- C. Trim, marker tray, and accessories.

1.2 RELATED SECTIONS

- A. Section 09 21 16 - Gypsum Board Assemblies: Substrate construction.

1.3 REFERENCES

- A. AHA A135.4 - Basic Hardboard.
- B. ASTM A424 - Steel Sheets for Porcelain Enameling.
- C. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- D. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- E. FS L-P-1040 - Plastic Sheets and Strips, Polyvinyl Fluoride.
- F. NPA A208.1 - Mat Formed Wood Particleboard.
- G. PEI (Porcelain Enamel Institute) - Performance specifications for Porcelain Enamel Chalkboards.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate wall elevations, dimensions, joint locations, and anchor details.
- C. Product Data: Provide data on markerboards, tackboards, trim and accessories. Include color and finish of markerboards and trim.
- D. Samples: Submit two samples illustrating color and texture of tackboard covering fabric; marker/projection screen surface.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01 78 23.
- B. Maintenance Data: Include data on regular cleaning, stain removal, and protection of surfaces.

1.6 QUALIFICATIONS

- A. Manufacturer: company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.8 WARRANTY

- A. Provide five-year warranty under provisions of Section 01 78 36.
- B. Warranty: Provide 50-year warranty on writing surface. Include coverage of markerboard surface from discoloration due to cleaning, crazing or cracking, staining and warping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. NACO/GSI.
- B. Lemco.
- C. Platinum Visual Systems.
- D. Claridge.
- E. Shana-Han's Ltd.
- F. Newline Products.
- G. Polyvision.
- H. Substitutions: Under provisions of Section 01 25 00.

2.2 MARKERBOARD MATERIAL

- A. Sheet Steel: ASTM A424, Type I, commercial quality.

2.3 TACKBOARD SURFACING MATERIAL

- A. Cork: Fine-grain natural cork, homogeneous composition.

2.4 CORE AND FRAME MATERIALS

- A. Hardboard: AHA A135.4, tempered, smooth face.
- B. Particle Board: NPA A208.1, wood chips, set with waterproof resin binder, sanded faces.
- C. Foil Backing: Aluminum foil sheet, 0.015 inch thick.
- D. Frame and Chalkrail: Aluminum extrusions, ASTM B221, 6064 alloy, T5 temper.

2.5 ACCESSORIES

- A. Adhesives: Type used by manufacturer.
- B. Map Supports: Formed aluminum sliding roller brackets to fit map rail.
- C. Flag Holders: Cast aluminum bored to receive one-half inch diameter flag staff, bracketed to fit top rail of markerboard and tackboard.
- D. Field Applied Trim: Snap on trim, with no visible screws or exposed joints.

- E. Marker Tray: Furnish standard continuous, solid extrusion (blade tray) type aluminum chalktray with ribbed section and smoothly curved exposed ends, for each markerboard.
- F. Map Rail: Furnish map rail at the top of each markerboard unit, complete with the following accessories:
 - 1. Display Rail: Provide continuous cork display rail integral with the map rail.
 - 2. End Stops: Provide one end stop at each end of the map rail.
 - 3. Map Hooks: Provide 2 map hooks with flexible metal clips for each 4 feet of map rail or fraction thereof.
- G. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- H. Provide instructions for markerboard cleaning on metal plate attached to perimeter frame near chalkrail.
- I. Provide liquid cleaner and cleaning towel kit for marker/projection screen wallcovering.

2.6 FABRICATION - MARKERBOARDS

- A. Outer Face Sheet: Steel, 28 gage enameling grade steel. Pressure laminated to core.
- B. Core: Particleboard, 7/16 inch thick, complying to requirements of ANSI A208.1, Grade 1-M-1. Not to emit significant quantities of formaldehyde.
- C. Backing Surface: 28 gage galvanized steel or 0.015 inch aluminum sheet.
- D. Splice Joint: Concealed spline of sheet steel.
- E. Laminating Adhesive: Moisture resistant thermoplastic type adhesive.

2.7 FABRICATION - TACKBOARDS

- A. Outer Facing: Cork, 1/4 inch thick. Laminated to core.
- B. Core: Hardboard, 1/4 inch thick.
- C. Backing Surface: Moisture barrier.

2.8 FABRICATION - FRAME AND TRIM

- A. Frame: Aluminum, of channel profile; concealed fasteners; 1 inch wide map rail with 3/4 inch x 1/4 inch cork insert over markerboard and tackboard surfaces. Two (2) map hooks with flexible metal clips per 4 feet of rail.
- B. Marker Tray: 2-3/4 inch deep aluminum, ribbed profile, one piece, full length of markerboard. Provide marker tray at all markerboards.

2.9 FINISHES

- A. Markerboard: Porcelain enamel, glass fibered, Type A acid-resistant; heat-fused to steel face sheet; ground enamel base coat on both sides of steel face sheet; color coat on writing surface; manufactured as specified by the Porcelain Enamel Institute. Medium gloss finish.
- B. Aluminum Frame, Marker Tray, and Accessories: Mill finish natural aluminum.

2.10 SIZES

- A. As noted on Floor Plans and Elevation Drawings.

PART 3

EXECUTION

3.1 EXAMINATION

- A. Verify that wall surfaces are ready to receive work and positioning dimensions are as indicated on shop drawings.

3.2 INSTALLATION

- A. Install markerboards and tackboards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.
- C. Markerboards: Butt panels tight with concealed spline to hairline joint.

3.3 CLEANING

- A. Clean work under provisions of Section 01 74 23.
- B. Cover markerboard and tackboard surfaces with protective cover, taped to frame.
- C. Remove temporary protective cover at date of Substantial Completion.

END OF SECTION

SECTION 10 21 13

SOLID COLOR REINFORCED COMPOSITE TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Urinal screens.

1.2 RELATED SECTIONS

- A. Section 09 21 16 - Gypsum Wall Assemblies: In wall framing and backing for partition panel support.
- B. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.
- C. Structural Drawings for Existing and New Wall Bracing Requirements.

1.3 REFERENCES (including, but not limited to:

- A. National Fire Protection Association 101 Life Safety Code 2006 Edition, Chapter 10.
- B. ANSI A117.1-1998 Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
- C. International Building Code (IBC), 2006 Edition, Chapters 8, 11 and 12.
- D. International Plumbing Code (IPC), 2006 Edition, Chapter 3, Section 10.
- E. Title 24, California Code of Regulations, Parts 2, 3 and 5.
- F. ADA, Accessibility Guidelines for Buildings and Facilities, Federal Register Volume 56, Number 144, Rules and Regulations.
- G. Fair Housing Amendments Act of 1988, Accessibility Guidelines, Federal Register Volume 56, Number 44.
- H. ASTM D2197-98(2002) - Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion.
- I. ASTM D2794-93(1999)e1 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- J. ASTM D6578-00 - Standard Practice for Determination of Graffiti Resistance.
- K. ASTM E84-01 - Standard Test Method for Surface Burning Characteristics of Building Material.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Indicate on shop drawings, partition plan and elevation views, dimensions, details and location of wall and floor supports,

- C. Provide product data on panel construction and accessories.
- D. Submit manufacturer's standard color chart with proposed color matching existing toilet partitions color.
- E. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle items to site under provisions of Section 01 66 00.
- B. Deliver items in manufacturer's original unopened protective packaging.
- C. Store materials in original protective packaging to prevent physical damage or wetting.
- D. Handle so as to prevent damage to finished surfaces.

1.6 WARRANTY

- A. Furnish ten-year limited warranty for panels against breakage, corrosion, delamination, and defects in factory workmanship.
- B. Furnish one-year guarantee against defects in material and workmanship for stainless steel mounting brackets.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Scranton Products.
- B. PSi SC.
- C. Comtec/Santana/Capitol Partitions, Inc.
- D. Toilet partitions shall be the product(s) of a single manufacturer.
- E. Substitutions: Under provisions of Section 01 25 13..

2.2 MOUNTING CONFIGURATIONS

- A. Urinal Screens shall be Wall-mounted.

2.3 COMPONENTS / MATERIALS

- A. Screens:
 - 1. Screens shall all be manufactured from Solid Color Reinforced Composite material. Color to match existing toilet partitions.
- B. Finish Thickness:
 - 1. Screens shall be 3/4".

- D. Hardware:
 - 1. All hardware to be 18-8, type 304 stainless steel with satin finish.
- E. Mounting Brackets:
 - 1. Mounting brackets shall be constructed of stainless steel, extend full height of panel, and shall be mounted back to wall substrate.
 - a. Locate at all panel-to-wall attachments.
 - 2. Wall mounted urinal screen brackets shall be 11-gauge double thickness.

2.4 PERFORMANCE REQUIREMENTS

- A. Graffiti Resistance: Partition material shall have the following graffiti removal characteristics when tested in accordance with ASTM D6578-00 - Standard Practice for Determination of Graffiti Resistance, in accordance with Section 9, "Graffiti Removal Procedure Using Manual Solvent Rubs":
 - 1. Cleanability: Five (5) required staining agents shall be cleaned off material.
- B. Scratch Resistance: Partition material shall have the following characteristics when tested in accordance with ASTM D2197-98(2002) - Standard Test Method for Adhesion of Organic Coating by Scrape Adhesion, using Gardner Stock #PA-2197/ST pointed stylus attachment on scrape tester:
 - 1. Scratch Resistance: Maximum Load Value shall exceed 10 kilograms.
- C. Impact Resistance: Partition material shall have the following characteristics when tested in accordance with ASTM D2794-93(1999)e1 - Standard Test Method for Resistance of Organic Coating to the Effects of Rapid Deformation (Impact), using .625" hemispherical indenter with 2-lb impact weight:
 - 1. Impact Resistance: Maximum Impact Force Value shall exceed 30 inch-lbs.
- D. Fire Resistance: Partition material shall comply with the following requirements, when tested in accordance with ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials:
 - 1. Smoke Developed Index: Not to exceed 450.
 - 2. Flame Spread Index: Not to exceed 75.
 - 3. Material Fire Ratings:
 - a. National Fire Protection Association (NFPA): Class B.
 - b. International Code Council (ICC): Class B.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that site conditions are ready to receive work, walls are plumb, and dimensions of bays to receive work of this Section are as indicated on shop drawings.
- B. Verify correct spacing of plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing as required.
- D. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 INSTALLATION

- A. Install screens secure, plumb, and level.

- B. Attach panel brackets securely to walls using anchor devices as recommended by manufacturer.
- C. Do not allow installed urinal screen and vertical uprights to extend more than 18 inches from finished surface of wall behind urinals.

3.3 ADJUSTING

- A. Replace all damaged material with new materials.

3.4 CLEANING

- A. Remove protective plastic coating.
- B. Clean exposed surfaces, hardware, and fittings.

END OF SECTION

SECTION 10 21 23
CUBICLE CURTAINS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Overhead metal curtain track and guides.
- B. Cubicle and shower curtains as identified in the Drawings.

1.2 RELATED SECTIONS

- A. Section 09 51 13 - Acoustical Panel Ceilings: Suspended ceiling system.

1.3 REFERENCES

- A. National Fire Protection Association - Standard 701.

1.4 PERFORMANCE REQUIREMENTS

- A. Track: To support vertical test load of 50 lbs without visible deflection of track or damage to supports.
- B. Size track to support moving loads, sufficiently rigid to resist visible deflection.

1.5 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01 33 00.
- B. Submit shop drawings indicating a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- C. Submit product data under provisions of Section 01 33 23.
- D. Submit product data for curtain fabric characteristics. Include manufacturer's standard color chart with proposed color indicated.
- E. Submit 12 x 12 inch sample patch of curtain cloth with representative hem stitch detail, heading with reinforcement, and carrier attachment to curtain header.
- F. Submit manufacturer's installation instructions under provisions of Section 01 33 23.

1.6 MAINTENANCE DATA

- A. Submit maintenance data under provisions of Section 01 78 23.
- B. Include recommended cleaning methods and materials and stain removal methods.

1.7 REGULATORY REQUIREMENTS

- A. Conform to NFPA Std. 701 for flame resistance requirements for curtain fabric.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01 45 17.

- B. Store and protect products under provisions of Section 01 45 17.
- C. Accept curtain materials on site and inspect for damage.
- D. Store curtain materials on site and deliver to the Owner for installation when requested.

PART 2 PRODUCTS

2.1 MANUFACTURERS - CUBICLE TRACKS AND CURTAINS

- A. Capital Cubicle Co., Inc.
- B. General Cubicle Co.
- C. Imperial Fastener Co., Inc.
- D. A.R. Nelson Co., Inc.
- E. OB/Masco Drapery Hardware Co.
- F. Watrous, Inc.
- G. Automatic Device Co.
- H. Belton Manufacturing Corp.
- I. Clickeze Corporation (Basis of Design).
- J. Substitutions: Under provisions of Section 01 25 00.

2.2 TRACK MATERIALS

- A. Track: Extruded aluminum sections, one piece per cubicle track run.
- B. Track Ends: Positive stop to fit track extrusion.
- C. Attachment Clips: Per manufacturers.
- D. Carriers: Nylon roller to accurately fit track, designed to eliminate bind when curtain is pulled, and fitted to curtain to prevent accidental curtain removal.

2.3 CURTAIN MATERIALS

- A. Curtain: 100% polyester, closely woven, anti-bacterial, self deodorizing, sanitized, flame-proofed to requirements of NFPA Standard 701. Color: Refer to Drawings.

2.4 FINISHING

- A. Exposed Aluminum Surfaces: Clear anodized aluminum.

2.5 FABRICATION

- A. Manufacture curtains of one OR two piece (s), sized 10 percent wider than track length. Terminate cubicle curtain 1 inch from floor; Refer to drawings for curtains of one or two

pieces

- B. Curtain heading of triple thickness 2 inches wide, with grommets holes for carriers 6 inches on center, double fold bottom hem 2 inches wide included lead weights. Lockstitch seams in two rows. Turn seam edges and lockstitch.
- C. Fabricate track bend with minimum 12-inch radius, without deforming track section, or impeding movement of carriers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and above ceiling supports are ready to receive work.
- B. Verify field measurements are as shown on Drawings.
- C. Beginning of installation means installer accepts existing surfaces and conditions.

3.2 INSTALLATION

- A. Install curtain track secure and rigid, true to ceiling line.
- B. Attach track to ceiling grid with attachment clips at 2'-0" o.c.
- C. Install end cap and stop devices.
- D. Install curtains on carriers ensuring smooth operation.

END OF SECTION

SECTION 10 28 00
TOILET ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Toilet accessories.
- B. Attachment hardware.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 09 21 16 - Gypsum Board Assemblies: Installation of concealed anchor devices.

1.3 RELATED SECTIONS

- A. Section 09 21 16 - Gypsum Board Assemblies: In-wall framing and plates for support of accessories.

1.4 REFERENCES

- A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible To and Usable by Physically Handicapped People.
- B. ANSI/ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips.
- C. ANSI/ASTM A366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
- D. ANSI/ASTM A386 - Zinc Coating (Hot-Dip) on Assembled Steel Products.
- E. ANSI/ASTM B456 - Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- F. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- G. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- H. NEMA LD-3 - High Pressure Decorative Laminates.

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 23.
- B. Provide product data on accessories describing size, finish, details of function, attachment methods.
- C. Submit manufacturer's installation instructions under provisions of Section 01 33 23.

- 1.6 KEYING
 - A. Supply two keys for each accessory to Owner.
 - B. Master key all accessories.
- 1.7 REGULATORY REQUIREMENTS
 - A. Conform to latest edition of the International Building Code for installing work in conformance with ANSI A117.1, 2003.
- 1.8 SEQUENCING AND SCHEDULING
 - A. Coordinate the work of this Section with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.
- PART 2 PRODUCTS
 - 2.1 MANUFACTURERS
 - A. Bobrick Washroom Equipment.
 - B. Bradley Corporation.
 - C. Gamco Equipment.
 - D. Substitutions: Under provisions of Section 01 25 00.
 - 2.2 MATERIALS
 - A. Sheet Steel: ANSI/ASTM A366.
 - B. Stainless Steel Sheet: ASTM A167, Type 304.
 - C. Fasteners, Screws, and Bolts: Hot dip galvanized, security type.
 - D. Tubing: ASTM A269, stainless steel.
 - E. Adhesive: Two component epoxy type, Contact type, waterproof.
 - F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.
 - 2.3 FABRICATION
 - A. Weld and grind smooth joints of fabricated components.
 - B. Form exposed surfaces from single sheet of stock, free of joints.
 - C. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
 - D. Back paint components where contact is made with building finishes to prevent electrolysis.
 - E. Shop assemble components and package complete with anchors and fittings.

- F. Provide steel anchor plates, adapters, and anchor components for installation.
- G. Hot dip galvanize exposed and painted ferrous metal and fastening devices.

2.4 FACTORY FINISHING

- A. Galvanizing: ANSI/ASTM A123 to 1.25 oz/sq yd.
- B. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- C. Chrome/Nickel Plating: ANSI/ASTM B456, Type SC 2 satin finish.
- D. Stainless Steel: No. 4 satin luster finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that site conditions are ready to receive Work of this Section.
- B. Beginning of installation means acceptance of existing conditions, substrate.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site at appropriate time for building-in.
- B. Provide templates and rough-in measurements as required.
- C. Verify exact location of accessories for installation.

3.3 INSTALLATION

- A. Install fixtures, accessories and items in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.

3.4 SCHEDULE

- A. Sanitary Napkin Dispenser: Fabricate cabinet of satin stainless steel, minimum 0.05 inch (18 gauge) thick, all welded construction. Provide door of seamless satin stainless steel, minimum 0.05 inch (18 gauge) thick, with returned edges and equipped with tumbler lockset. Provide identification reading "tampons" and "napkins" at coin slots; brand name advertising not allowed. Capacity not less than 15 napkins and 20 tampons.
 - 1. Mounting:
 - a. Surface-mounted type. No. B-2706.
 - b. Semi-recessed mounted type. No. B-370639.
 - 2. Operation: Convertible free/twenty-five cent single coin operation, with locked coin box keyed separately from door and other accessory units.
- B. Partition Mounted Sanitary Napkin Disposal Units: Fabricate of Type 304 satin stainless steel, 18 gauge, for mounting to toilet partition, self-closing door, and removable stainless steel receptacle of all welded construction. No. B-354.
- C. Surface Mounted Sanitary Napkin Disposal Unit: Fabricate of

Type 304 satin stainless steel, 18 gauge, for nominal 4-inch wall depth, cover secured with piano hinge, radiused corners, all welded construction. No. B-2706.

- D. Grab Bar: Type 304 polished stainless steel, 18 gauge, 1-1/4 inch o.d., ends welded to flanges; distance to finished wall: 1-1/2 inches; with concealed mounting plates firmly attached to sustain loads in excess of 900 lbs. and complying with ADAAG requirements. Lengths as shown on drawings.
- E. Roll Toilet Tissue Dispenser, Compact Side by Side, Owner Furnished, Owner Installed: Georgia Pacific, #56784. Provide this dispenser at all toilets.
- F. Robe Hooks
 - 1. Double Prong Hook. Bobrick B-672, satin finish. To be surface mounted at back of door at each stall. Mount them at accessible height in compliance with ANSI – A 117.1
- G. Wall-Mounted Baby Changing Station: Bobrick KB200-SS. Polypropylene cabinet and bed with stainless steel veneer; color – Grey.

END OF SECTION

MANUAL ROLLER SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manually operated roller shades.

1.2 RELATED SECTIONS

- A. Section 09 21 16 – Gypsum Board Assemblies.
- B. Section 09 51 13 – Acoustical Panel Ceilings.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data indicating physical and dimensional characteristics, and operating features.
- C. Samples: Submit two samples each, illustrating blade materials, finish, and color; cord and bead chain type and color; valance type and color.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, attachment details.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.

1.5 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.6 COORDINATION

- A. Coordinate work under provisions of Section 01 31 13.
- B. Install the work after window, ceiling, and painting work is completed in rooms scheduled to receive work of this section.

1.7 EXTRA MATERIALS

- A. Provide under provisions of Section 01 78 43.
- B. Provide ten (10) additional blades of each color of the longest length.
- C. Provide three (3) extra control cords and bead chains.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.9 WARRANTY

- A. Warranty: Provide manufacturer's standard warranties, including the following:
 - 1. Roller Shade Hardware, and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.
 - a. Standard non-depreciating 10-year limited warranty.
 - 2. Roller Shade Installation: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. MechoSystems: EuroTwill Reversible Weave – 6000 Series; 3% open.
- B. Operation: Manual.

2.2 SHADE BANDS

- A. Shade Bands: Construction of shade band includes the fabric, the enclosed hem weight, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
 - 1. Concealed Hembar: Shall be continuous extruded aluminum for entire width of shade band and with the following characteristics:
 - a. Hembar shall be heat sealed on all sides.
 - b. Open ends shall not be accepted.
 - 2. Shade Band and Shade Roller Attachment:
 - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
 - b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
 - c. Mounting Spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
 - d. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

2.3 ROLLER SHADE FABRICATION

- A. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch in either direction per 8 feet of shade height due to warp distortion or weave design.
- B. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shade bands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.
- C. For railroaded shade bands, provide seams in railroaded multi-width shade bands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shade bands

- D. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shade bands.
- E. Blackout shade bands, when used in side channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet on center extending fully into the side channels. Battens shall be concealed in an integrally colored fabric to match the inside and outside colors of the shade band, in accordance with manufacturer's published standards for spacing and requirements.
 - 1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.

2.4 ROLLER SHADE COMPONENTS

- A. Access and Material Requirements:
 - 1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
 - 2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive, or operating support brackets.
 - 3. Use only Delran engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester shall not be accepted.
- B. Manual Operated Chain Drive Hardware and Brackets:
 - 1. Provide for universal, regular, and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
 - 2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
 - 3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
 - 4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer's design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.
 - 5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
 - 6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.
 - 7. Provide shade hardware constructed of minimum 1/8-inch thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
 - 8. Drive Bracket / Brake Assembly:
 - a. MechoShade Drive Bracket model M5 shall be fully integrated with all MechoShade accessories, including, but not limited to: SnapLoc fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
 - b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8-inch steel pin.
 - c. The brake shall be an over running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. in the stopped position.

- d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.
- e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.
- 9. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. minimum breaking strength. Nickel plate chain shall not be accepted.

2.5 SHADECLOTH

- A. Visually Transparent Single-Fabric Shadecloth: MechoSystems, EuroTwill 6000 Series: 0.010 diameter, Opaque, non-raveling vinyl-polyester yarn, fabric thickness 0.025 inches.
 - 1. Extra Dense Twill Weave 6000 Series, 3% open.
 - 2. Color. Per Finish Materials Schedule (Refer to Set of Documents).
- B. Fascia:
 - 1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
 - 2. Fascia shall be able to be installed across two or more shade bands in one piece.
 - 3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
 - 4. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
- C. Room Darkening Side and Sill Channels:
 - 1. Extruded aluminum with polybond edge seals and SnapLoc-mounting brackets and with concealed fastening. Exposed fastening is not acceptable. Channels shall accept one-piece exposed blackout hembar with vinyl seal to assure side light control and sill light control.
 - a. MechoSystems side channels, 1-15/16 inches wide by 1-3/16 inches deep, two-band center channels, 2-5/8 inches wide by 1-3/16 inches deep. The 2-5/8-inch double-center channels may be installed at center-support positions of multi-band-shade.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings are ready to receive the work.
- B. Coordinate with other trades for securing tracks to substrates and other finished surfaces.

3.2 INSTALLATION

- A. In rooms with markerboard or tackboards, do not install cords over markerboards and tackboards.
- B. Install blinds in accordance with manufacturer's instructions.
- C. Securely anchor units with clips, brackets, and anchorages suited to type of substrate.
- D. Install valance to conceal head track and mounting hardware.
- E. Blinds to be installed where scheduled.

3.3 ADJUSTING

- A. Adjust work to permit unencumbered operation of hardware.
- B. Adjust shades for smooth operation.

3.4 CLEANING

- A. Clean work under provisions of 01 74 23.
- B. Clean blind surfaces just prior to occupancy.

END OF SECTION

METAL LABORATORY CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Laboratory Casework and Casework for Equipment.
- B. Supporting Structures.
- C. Miscellaneous Items of Utility Service, Including Plumbing and Electrical Fittings.
- D. Assembling and Secure.

1.2 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrications (Shop Fabricated Ferrous Metal Items).
- B. Section 09 65 19 – Resilient Flooring and Base.
- C. Section 12 36 53– Laboratory Worksurfaces.
- D. Plumbing – See Plumbing Documents.
- E. Electrical - See Electrical Documents.

1.3 RELATED PUBLICATIONS

- A. SEFA 3 – Scientific Equipment and Furniture Association – Work Surfaces.
- B. SEFA 8 – Scientific Equipment and Furniture Association – Laboratory Furniture, Casework, Shelving and Tables.
- C. NFPA 30 – National Fire Protection Association - Storage, Handling, and Use of Flammable and Combustible Liquids, including Waste Liquids.
- D. NFPA 45 – National Fire Protection Association - Laboratory Buildings, Laboratory Units, and Laboratory Work Areas Whether Located Above or Below Grade in Which Chemicals, as defined in NFPA 704 are used.
- E. UL – Underwriter Laboratories.
- F. ASTM D522 – Bending Test.

1.4 SUBMITTALS

- A. Product Data: For each type of product specified. Indicate product description, fabrication information, and compliance with specified performance requirements.
- B. Shop Drawings:
 - 1. Show location of each item, dimensioned plans and elevations, ends, cross-sections, service run spaces, location and type of service fittings, large-scale details, attachment devices and other components drawn accurately to scale. Show the following as a minimum:
 - a. Full-size details, edge details, attachments, etc.

- b. Profiles and product components, including edge conditions, joints, fitting and fixture locations, anchorage, accessories and finish colors.
 - c. Locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
 - d. Locations and sizes of cutouts and holes for electrical, plumbing and other items installed within casework and/or requiring adaptability of casework.
 - e. Verified actual field measurements/ openings.
 - f. Fabrication schedule with construction progress to avoid construction delays.
 - g. Coordination of Shop Drawings with other work involved.
 - h. Rough-in in drawings for plumbing, electrical and other similar.
- C. Data for Painting of Existing Casework In-Situ, illustrating color, texture and finish to match new products being supplied and installed under this section.
- D. Maintenance and care data including repair and cleaning instructions.
- E. Maintenance kit for finishes per Section 01 78 43.
- F. Instructions and Recommendations for Users.
- G. Installation Instructions and Dis-assembling Methods.
- H. Performance Test Requirements Results.

1.5 QUALITY ASSURANCE

- A. Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required and currently installed for this project and whose products have a record of successful in-service performance.
- B. Fabricator/Installer Qualifications: Work of this Section shall be by a certified fabricator/installer, certified in writing by the manufacturer. Primary products furnished by a single manufacturer with minimum ten (10) years documented experience in work of this section. Installer must have a minimum of five (5) years documented experience in work of this section.
- C. General Performance: Provide independent test lab certification that Metal Laboratory Casework meets the performance requirements described in SEFA 8.
- D. Finish Performance: Provide independent test lab certification that Metal Laboratory Casework meets the performance requirements described in Section 2.2 of these specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do Not Deliver Casework to project site until areas are ready for installation.
- B. Store Casework and accessories indoors prior to installation.
- C. Handle materials to prevent damage to finished surfaces.
 - 1. Provide protective coverings to prevent physical damage during shipping, handling, installation and following installation for duration of project.
- E. Delivery: Use suitable protection material during transportation. Package materials to prevent damage during shipping and handling.

- F. Storage: Store products in enclosed area. Maintain products in manufacturer's unopened packaging until ready for installation. Use protective dividers to avoid damage to finished surfaces.

1.7 WARRANTY

- A. Provide manufacturer's warranty against defects in materials, workmanship and installation.

1.8 PROJECT CONDITIONS:

- A. Do not install products under environmental conditions outside of manufacturer's limits.
- B. Avoid installing products until HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the installation and the remainder of the construction period.
- C. Located concealed framing, blocking and reinforcement support casework by field measurements, indicating such measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Air Master Systems (AMS).
- B. Kewaunee Scientific Corporation.
- C. Substitutions: Submit to Architect for approval.

2.2 MATERIALS

- A. Materials as part of the completed product: All steel used in the manufacture of metal casework shall be cold rolled, prime grade, or better. Steel shall be inspected prior to fabrication and certified to be free of rust, pits, scratches, or any other defects. materials shall be of the highest quality, whether they be finished parts used in assembly, raw material, or materials and workmanship furnished by others, as part of the completed product.

Gauges: Gauge specifications for individual steel parts shall meet the minimum acceptable physical performance in accordance with SEFA 8 testing procedures and as follows:

a.	Aprons	18 Ga.
b.	Back Panels	20 Ga.
c.	Bottom Panels	18 Ga.
d.	Door & Drawer Outer Pan	20 Ga.
e.	Door & Drawer Inner Pan	20 Ga.
f.	Drawer Bodies	20 Ga.
g.	Legs, 2" Square Tube	18 Ga.
h.	Shelves	18 Ga.
i.	Side Panels	18 Ga.
j.	Table Frames	18 Ga.
k.	Shelf Support Brackets	14 Ga.

2.3 PERFORMANCE REQUIREMENTS

- A. Performance Requirements for Steel Casework Construction:
 - 1. Base cabinets shall be constructed to support at least a uniformly distributed load 200 pounds per square foot of cabinet top area, including working surface without objectionable distortion of interference with door and drawer operation.

2. Base cabinet leveling bolts shall support 500 pounds per corner, at 1 1/2" projection of the leveling bolt below the cabinet bottom.
 3. Each adjustable and fixed shelf 4 feet or shorter in length shall support an evenly distributed load of 40 pounds per square foot up to a maximum of 200 pounds, with nominal temporary deflection, but without permanent set.
 4. Full extension soft-close, self-closing ball bearing zinc plated drawer slide shall be rated for 100 pound loads.
 5. Swinging doors on floor-mounted inset style casework shall support 200 pounds suspended at a point 12" from hinged side, with door swung through an arc of 160 degrees. Weight load test shall allow only a temporary deflection, without permanent distortion or twist. Door shall operate freely after test and assume a flat plane in a closed position.
- B. Steel Paint System Finish and Performance Specification:
1. Steel Paint System Finish:
 - a. After Cold Rolled Steel and Textured Steel component parts have been completely welded together and before finishing, they shall be given a pre paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.
 - b. After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a chemical and corrosion resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, insuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.
 - c. The completed finish system shall meet the performance test requirements specified under SEFA 8.
- C. Performance Test Requirements in Compliance with SEFA 8:
1. Chemical Spot Test.
 2. Impact Resistant Test.
 3. Bending Test.
 4. Adhesion Test.
 5. Hardness Test.

2.4 FABRICATION AND CONSTRUCTION

- A. Cabinets:
Cabinets shall be constructed of prime 18 gauge steel for the sides, backs, and toe space. 1" X 18 Gauge steel tubing shall be used for the top front and back rails. Each front joint is to be welded and ground flush to provide a smooth surface. A 4' high X 3' deep toe space shall be standard. Four corners are to be fitted with a stamped and welded 14 gauge leveling gusset plate, and a plated leveling screw.
Leveling screws are provided with a slot for easy adjustment, and non-marking nylon glides. Removable back panels shall be furnished on all cabinets. Cabinet bottom will be panned up to contain spills and removable for easy cleaning and maintenance.
- B. Doors - Base Cabinet Doors:
Doors shall be double pan construction, with insulating material fastened to the inside for sound deadening, and strength, to prevent panning and bending. Hinges are five knuckle gauge stainless steel, fastened to both the door and cabinet frame with zinc plated steel screws. Door catches plated, friction roller type. Door closes onto nylon bumpers for noise dampening, and over nylon spacers for alignment.

- C. Drawers:
Drawer bodies shall be one piece 20 gauge construction, fully coved on all four sides horizontally and formed out of one sheet of steel.
- D. Drawer Suspension:
Drawers shall operate on full extension, ball bearing, zinc plated, drawer suspension rated to withstand 10,000 cycles at 100 lbs.
- E. Shelves on Guide Brackets:
Shelves shall be constructed of 18 gauge steel, with channels formed on both the front and back edges. Front needs to have lip guard edge. K & V shelf clips are made from 14 gauge steel, and are to be adjustable vertically in 1" increments. Sliding shelves shall use the same ball bearing slides as drawer units.
- F. Fabricated Accessories
All accessories required for specific installations shall be fabricated and finished to the same material and quality standards as the base units they will be made to compliment.
- G. Wall Cabinets:
Wall cabinets shall be made to the same quality standards as base units. Material used, as noted above. Shelf hangers are to be constructed of 14 gauge steel, and to easily adjust vertically in one inch increments.

Shelves are to be constructed with channel type fronts and backs. Wall units to have open fronts, sliding glass, framed glass sliding and swinging, or sliding and swinging steel doors as specified.

Glass is plate, ground on all exposed edges.

Sliding door units to be furnished with extruded top and bottom channels as well as ball bearing rollers. All wall units are to be furnished with hanger brackets for ease of installation.

2.5 FINISH

All surfaces shall be painted, whether they are exposed or not. Paint shall be a chemically resistant baked on epoxy powder coat enamel, conforming to requirements stated elsewhere in this specification section.

Manufacturability

The material shall be such that it can be applied in multiple coatings where needed, without intercoat sanding. The shelf life of the material shall be (six (6) months) at not more the 77 degrees without deterioration of properties.

Appearance

Description	Test Procedure	Requirement
A. Color	AES-C-0100	Pass
B. Light Resistant	QUV A Apparatus	48 hours w/o change in color or gloss
C. Thickness	Mill Gage	See page 3 of 3
D. Glass	ASTM D523-80	30 Degree + 5 Matte
	60 Degrees Glossmeter	20 Degree + 5 Black

Performance

A. Hardness	ASTM D3363-74 (no indeptation)	3-H Min.

B. Impact Resistance	ASTM D2794-69	120 in-lbs w/o cracking
C. Flexibility	ASTM D522-60	No cracking or loss of adhesion at bend
D. Abrasion	Tabor abrasor CS 10 Wheel	14 mg. max. weight loss per 100 cycle
E. Humidity	ASTM D2247	288 hours exposure with no loss of adhesion or blistering
F. Salt Spray	ASTM B117-64	144 hours exposure with no rust.
	ASTM D1654-79	Max 1/8" rust creep from scribe line
G. Adhesion		90 of the squares show finish.
H. Chemical Resistance	A door shall be removed from the cabinets and laid flat and level on a horizontal surface. Chemical spot tests shall be made by applying 10 drops (approximately 0.5 cm ³) of each reagent listed in Table 1 to the surface to be tested. Each reagent spot shall be open to the atmosphere. Ambient temperature shall be 68-72 degrees F (20-22 degrees C). After one hour, chemical shall be flushed away with cold water and the surface washed with detergent and warm water at 150 degrees F (65 degrees C). Surface shall then be examined under 100 degree foot candles of illumination.	A max. of three failure classifications shall be acceptable.

APPEARANCE SURFACE	MIN. MILLAGE	SURFACE CLASS
Fillers	1.2	A
Front of Cabinet or Case Including Drawer and Door Fronts		
Shelf Tops	1.2	B
Top of Wall and Floor Cases	1.2	B
Cabinet and Case Floors	1.2	B
All other than above interior and exterior vertical surfaces	1.0	B

NON-WORKING SURFACES

All other than above unexposed surfaces

.75

C

CONDITION	SURFACE "A"	SURFACE "B"	SURFACE "C"
Blemish	No	Not permitted on surfaces easily detected from an arms length.	Yes
Water Spot	No	Not permitted on surfaces easily detected from an arms length.	Yes
Sag	No	Slight	Yes
Over Cure	No	No	Yes
Under Cure	No	No	Yes

PART 3 EXECUTION

3.1 INSTALLATION

- A. Preparation: Prior to beginning installation of casework, check and verify that no irregularities exist that would affect quality of execution of work specified.
- B. Coordination: Coordinate the work of the Section with the schedule and other requirements of other work being prepared in the area at the same time both with regard to mechanical and electrical connections to and the general construction work.
- C. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet (1.5 mm in 3 m).
 - 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet (3 mm in 3 m).
 - 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet (3 mm in 3 m).
 - 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
 - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.5 mm).
- D. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.
- E. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches (400 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches (600 mm) o.c. and at sides of cabinets with not less than two fasteners per side.
- F. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches (400 mm) O.C., U.N.O.

- G. Install hardware uniformly and precisely. Set hinges snug and flat in mortises. Match hardware with existing cabinet hardware. Replace/ exchange hardware where required to match uniformity per complete room. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.2 INSTALLATION OF SERVICE FITTINGS

- A. Comply with requirements in other Sections for installing water service fittings and electrical devices.
- B. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.2 CLEANING AND PROTECTION

- A. Keep components clean during installation.
- B. Protect surfaces from damage until date of substantial completion.
- C. Replace damaged work.

END OF SECTION

LABORATORY WORKSURFACES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Epoxy Resin Worksurfaces, inclusive of sinks and accessories.
- B. Setting Materials.

1.2 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrications (Steel Supports).
- B. Section 07 90 00 - Joint Protection.
- C. Section 12 35 00 – Specialty Metal Casework.
- D. Plumbing – See Plumbing Documents.
- E. Electrical - See Electrical Documents.

1.3 REFERENCES

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- C. ASTM D570 – Standard Test Method for Water Absorption of Plastics.
- D. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- E. ASTM D648 – Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in edgewise Position.
- F. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics.
- G. ASTM D696 – Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between - 300 C and 300 C With a Vitreous Silica Dilatometer.
- H. ASTM D785- Standard - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
- I. ASTM D790 – Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- J. ASTM D792 – Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
- K. ASTM D3801 – Standard Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position.
- L. UL – Fire Resistance Directory.
- M. UL 723 – Tests for Surface Burning Characteristics of Building Materials.

- N. GreenGuard Environmental Institute (GREENGUARD):
 - 1. Indoor Air Quality Certification Program.
 - 2. Children and Schools Certification Program.
- O. International Organization for Standardization (ISO) 9001 - Quality Management Systems - Requirements.
- P. NSF International / American National Standards Institute (NSF/ANSI) - 51 - Food Equipment Materials.
- Q. Scientific Certification Systems (SCS) - Recycled Content Certifications.
- R. Scientific Equipment and Furniture Association (SEFA) 3 - Work Surfaces.

1.4 SUBMITTALS

- A. Product Data: For each type of product specified. Indicate product description, fabrication information, and compliance with specified performance requirements.
- B. Shop Drawings:
 - 1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components drawn accurately to scale. Show the following as a minimum:
 - a. Full-size details, edge details, attachments, etc.
 - b. Profiles and product components, including edge conditions, joints, fitting and fixture locations, anchorage, accessories and finish colors.
 - c. Locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
 - d. Locations and sizes of cutouts and holes for electrical grommets and other items installed in the surface.
 - e. Verified actual field measurements/ openings.
 - f. Fabrication schedule with construction progress to avoid construction delays
- C. Samples: Two (2) samples of each specified material, minimum 6" x 6" in size, illustrating color, texture and finish.
- D. Maintenance and care data including repair and cleaning instructions.
- E. Maintenance kit for finishes per Section 01 78 43.
- F. Preparation Instructions and Recommendations.
- G. Recommended Installation Methods.

1.5 QUALITY ASSURANCE

- A. Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required and currently installed for this project and whose products have a record of successful in-service performance.
- B. Fabricator/Installer Qualifications: Work of this Section shall be by a certified fabricator/installer, certified in writing by the manufacturer. Primary products furnished by a single manufacturer with minimum ten (10) years documented experience in work of this section. Installer must have a minimum of five (5) years documented experience in work of

this section.

- C. Test Reports: Submit Certified test reports or recognized evaluation reports showing compliance with specified performance characteristics and physical properties.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver no components to project site until areas are ready for installation.
- B. Store components indoors prior to installation.
- C. Handle materials to prevent damage to finished surfaces.
 - 1. Provide protective coverings to prevent physical damage or staining following installation for duration of project. Remove stickers immediately after installation. Do not remove protective film until panel has been installed.
- D. Delivery: Use pallets larger than sheets during transportation. Package materials to prevent damage during shipping and handling.
- E. Storage: Store products in enclosed area to protect from ultraviolet. Maintain products in manufacturer's unopened packaging until ready for installation. Use protective dividers to avoid damage to surfaces. Horizontal storage is required, store sheets on pallets of equal or greater size than sheets with protective layer between pallet and sheet and on top of uppermost sheet. Do not store sheets or fabricated panels vertically.

1.7 WARRANTY

- A. Provide manufacturer's 10-year warranty against defects in materials.
 - 1. Warranty shall provide material to repair or replace defective materials.

1.8 PROJECT CONDITIONS:

- A. Do not install products under environmental conditions outside of manufacturer's limits.
- B. Avoid direct exposure of products to sunlight.
- C. Do not use work surfaces as bench, ladder or seating.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Durcon.
- B. Trespa.
- C. Substitutions: Submit to Architect for approval.

2.2 MATERIALS

- A. Solid Epoxy Resin: Sheets cast from modified epoxy resin and non-asbestos inert fillers; compounded mixture cured and thermoset specifically from formulation to provide exceptional physical and chemical resistance required in medium to heavy duty laboratory environments. Physical Properties: minimum acceptable physical performance in accordance with SEFA 3 testing procedures:
 - a. Density/specific gravity: Tested to ASTM D792; minimum test rating of 134.8 PSF or 2.16 gcm.

- b. Rockwell hardness: Tested to ASTM D785; minimum M scale rating of 110.
 - c. Fire resistance: tested to ASTM D635; classified as self-extinguishing.
 - d. Surface burning characteristics: Tested to ASTM E84; flame spread index 7.4 and smoke develop index of 221.2.
 - e. Surface burning characteristics in vertical position: Tested to ASTM D3801; maximum flame spread index of 7.4 and smoke developed index of 221.2.
 - f. Coefficient of linear thermal expansion: Tested to ASTM D696; rating of 2.46×10^{-5} .
 - g. Heat deflection: Tested to ASTM D648; maximum 205 degrees F or 96 degrees C.
 - h. Flexural strength: Tested to ASTM D790; minimum rating 14.9 KPSI or 103 Mpa.
 - i. Flexural modulus: Tested to ASTM D790; 2,777,501 PSI or 19.2 Gpa.
 - j. Water absorption, 24 hours: tested to ASTM D570; maximum 0.008 percent by weight.
 - k. Compression strength: Tested to ASTM D695; minimum 38.4 kpsi or 265 Mpa.
 - l. Chemical resistance; minimum acceptable chemical resistance performance in accordance with SEFA 3.
- B. Joint Adhesive, panel adhesive and sealants: As approved by manufacturer, to match solid surfacing color.

2.5 FABRICATION

- A. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions and technical bulletins. Tops, components and accessories need to be fabricated in accordance with SEFA 3.
- B. Form joints between components using manufacturer's standard joint adhesive joints. Reinforce as required.
- C. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
- D. Rout and finish component edges.
 - 1. Rout cutouts, radii and contours to template.
 - 2. Smooth radius edges.
- E. Epoxy Resin Work-surfaces
 - 1. Thickness: One (1) inch. Check each sheet at factory for required thickness before shipping. Maximum variation in thickness not to exceed 1/16 inch in 36 inch span or 3/16 inch in 96 inch span.
 - 2. Warpage: Inspect tops for warpage prior to fabrication by placing on true flat surface. Maximum allowable warpage is 1/16 inch in 36 inch span or 3/16 inch in 96 inch Span.
 - 3. Fabrication: Bond joints with highly chemical resistant cement with properties and color similar to base material. Provide 1/8 " drip groove at underside of exposed edges, set back 1/2" from face. Finish exposed edges. Edge Treatment: Match existing countertops edge finish treatment and shape. Corner treatments need to be eased slightly for safety. Tops at different heights butting each other need to be treated with backsplashes on the lower side matching the height of the backsplash on the higher side. The difference in height between the tops need to be covered by a vertical counter surface. The minimum backsplash height is 4 inches and it shall match the existing countertops backsplashes shape. Provide sink cutouts of the sizes and dimensions indicated per the documents.
- F. Epoxy Resin Sinks:
 - 1. Mold sinks from thermosetting epoxy resin.

2. Mold interior corners to radius. Slope sink base to drain outlet.
3. Provide 1-1/2 inch (38 mm) outlet with open ended standpipe; standpipe overflow 2 inches (50 mm) shorter than depth of sink.
4. Unless otherwise indicated, fabricate sinks of drop-in design supported by upper flange from worksurface.
5. Color: To match adjacent worksurface.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install components plumb and level, in accordance with approved shop drawings and product installation details.
 1. Tops:
 - a. Flat and true to within 1/8" of a flat surface over a 10' length.
 - b. Allow a minimum of 1/16" to a maximum of 1/8" clearance between surface at each wall.
- B. Form field joints using manufacturer's recommended adhesive, with joint widths no greater than 1/8" in finished work.
- D. Provide backsplashes and endsplashes as indicated on the drawings and described under this specification.
- E.
 1. Adhere to countertops using manufacturer's standard color-matched silicone sealant.
- C. Keep components and hands clean during installation.
 1. Remove adhesives, sealants and other stains.
 2. Components shall be clean on date of substantial completion.

3.2 CLEANING AND PROTECTION

- A. Keep components clean during installation.
- B. Remove adhesives, sealants and other stains.
- C. Protect surfaces from damage until date of substantial completion.
- D. Replace damaged work.

END OF SECTION

SOLID SURFACING COUNTERTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid surfacing countertops.

1.2 RELATED SECTIONS

- A. Section 07 90 00 - Joint Protection.
- B. Electrical - See Electrical Drawings.

1.3 REFERENCES

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- C. UL – Fire Resistance Directory.
- D. UL 723 – Tests for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Product Data: For each type of product specified. Indicate product description, fabrication information, and compliance with specified performance requirements.
- B. Shop Drawings:
 - 1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components drawn accurately to scale. Show the following:
 - a. Full-size details, edge details, attachments, etc.
 - b. Locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
 - c. Locations and sizes of cutouts and holes for electrical grommets and other items installed in quartz surface.
 - d. Seam locations.
- C. Samples: Two (2) samples of each specified material, minimum 6" x 6" in size, illustrating color, texture and finish.
- D. Maintenance and care data including repair and cleaning instructions.
- E. Maintenance kit for finishes per Section 01 78 43.

1.5 QUALITY ASSURANCE

- A. Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.
- B. Fabricator/Installer Qualifications: Work of this Section shall be by a certified fabricator/installer, certified in writing by the manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver no components to project site until areas are ready for installation.
- B. Store components indoors prior to installation.
- C. Handle materials to prevent damage to finished surfaces.
 - 1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 WARRANTY

- A. Provide manufacturer's 10-year warranty against defects in materials.
 - 1. Warranty shall provide material to repair or replace defective materials.

PART 2 PRODUCTS

2.1 MANUFACTURER (SOLID SURFACING)

- A. DuPont.
- B. Samsung.
- C. Substitutions: Submit to Architect for approval.

2.2 MATERIALS

- A. Solid Surfaces: Solid Polymer components. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.

1. Performance Characteristics

<u>Property</u>	<u>Typical Result</u>	<u>Test</u>
Tensile Strength	6,000 psi	ASTM D638
Tensile Modulus	1.5×10^{-6} psi	ASTM D638
Tensile Elogation	0.4% min.	ASTM D638
Flexural Strength	10,000 psi	ASTM D790
Flexural Modulus	1.2×10^{-6} psi	ASTM D790
Hardness	>85	Rockwell "M" Scale
	56	ASTM D785
		Barcol Impressor
		ASTM D2583
Thermal Expansion	3.02×10^{-5} in./in./°C (1.80×10^{-5} in./in./°F)	ASTM D696
Gloss (60° Gardner)	5-75 (matte-highly polished)	ANSI Z124
Light Resistance	(xenon arc) No effect	NEMA LD 3-2000 Method 3.3
Wear and Cleanability	Passes	ANSI Z124.3 and ANSI Z124.6

<u>Property</u>	<u>Typical Result</u>	<u>Test</u>
Stain Resistance: Sheets	Passes	ANSI Z124.3 and ANSI Z124.6
Fungus and Bacteria Resistance	Does not support microbial growth	ASTM G21 & G22
Boiling Water Resistance	No visible change	NEMA LD 3-2000 Method 3.5
High Temperature Resistance	No change	NEMA LD 3-2000

Izod Impact (Notched Specimen)	0.28 ft.-lbs./in. of notch	Method 3.6 ASTM D256 (Method A)
Ball Impact	No fracture – ½ lb. ball:	NEMA LD 3-2000
Resistance: Sheets	¼" slab – 36" drop ½" slab – 144" drop	Method 3.8
Weatherability	ΔE* ₉₄ < 5 in 1,000 hours	ASTM G155
Specific Gravity†	1.7	
Water Absorption	Long-term 0.4% (¾") 0.6% (1/2") 0.8% (1/4")	ASTM D570
Toxicity	99 (solid colors) 66 (patterned colors)	Pittsburgh Protocol Test ("LC50" Test)
Flammability	All colors (Class I and Class A)	ASTM E84, NFPA 255 and UL 723
Flame Spread Index	<25	
Smoke Developed Index	<450	

† Approximate weight per square foot: ¼" 2.2 lbs., ½" 4.4 lbs.

2. Thickness 1-1/8"; feather miter edge; or equal.
3. Color: As specified on drawings.

B. Joint Adhesive: As approved by manufacturer, to match solid surfacing color.

2.5 FABRICATION

- A. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions and technical bulletins.
- B. Form joints between components using manufacturer's standard joint adhesive joints. Reinforce as required.
- C. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
- D. Rout and finish component edges.
 1. Rout cutouts, radii and contours to template.
 2. Smooth radius edges.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install components plumb and level, in accordance with approved shop drawings and product installation details.
 1. Tops:
 - a. Flat and true to within 1/8" of a flat surface over a 10' length.
 - b. Allow a minimum of 1/16" to a maximum of 1/8" clearance between surface and each wall.
- B. Form field joints using manufacturer's recommended adhesive, with joint widths no greater than 1/8" in finished work.

- C. Provide backsplashes and endsplashes as indicated on the drawings.
 - 1. Adhere to countertops using manufacturer's standard color-matched silicone sealant.
- D. Keep components and hands clean during installation.
 - 1. Remove adhesives, sealants and other stains.
 - 2. Components shall be clean on date of substantial completion.

3.2 CLEANING AND PROTECTION

- A. Keep components clean during installation.
- B. Remove adhesives, sealants and other stains.
- C. Protect surfaces from damage until date of substantial completion.
- D. Replace damaged work.

END OF SECTION

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Perform site excavation, trenching, hauling, backfilling, compaction of materials and sub-grade preparation required to construct the site work indicated or shown on the Contract drawings.
- B. Contractor shall perform a site visit prior to bid to observe the existing conditions of the areas where site work is indicated.
- C. The following is additional responsibility of the Contractor under this section:
 - 1. Preparation of sub grade for slabs, walks, and pavements as required as part of this work.
 - 2. Repairs of adjacent site slabs, walks and pavements as a result of the site work scope indicated by the Construction Documents.
- D. Perform and adjust finished grading for adjacent areas to site work indicated.
- E. Protect existing utilities and improvements that are designated to remain or be protected.
- F. Dispose of unsuitable excavated material, including contaminated material off Owner's property. Disposal to be performed per governing agency requirements and specifications.
- G. Grade all areas of site work described per the Construction Documents leaving proper drainage and slopes.

1.2 RELATED SECTIONS

- A. Section 01 40 00 – Quality Control.
- B. Section 01 43 26 – Testing and Inspecting Agency.
- C. Section 02 00 00 – Site Preparation.

1.3 PERMITS, ORDINANCES

- A. Procure and pay for all necessary permits or certificates required by local authorities having jurisdiction over the work.
- B. Comply with all applicable Federal, State, and Local ordinances.
- C. Procure and pay for a dust permit that is to include the project site affected areas by the site scope of work. The Contractor will also be responsible for the installation and maintenance of a construction/security fence of the site areas of work

1.4 LAYOUT

- A. Layout of all work under this section, including all lines and levels, shall be made by a licensed surveyor or civil engineer licensed in the State of Nevada.

- B. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation. If necessary to disturb existing benchmarks, a Professional Land Surveyor licensed in the State of Nevada shall be used to re-establish it in a safe place. The Contractor shall be responsible for the protection or re-establishment of any monument of record shown on the plans or found during the course of construction in accordance with NRS 329.
- C. If any discrepancies are found by surveyor between drawings and actual conditions at the site, the Engineer/ Architect shall be notified and reserves the right to make such minor adjustments in work specified as necessary to accomplish the intent of the contract documents, without increased cost to Owner.

1.5 CODES, STANDARDS AND REFERENCES

- A. Apply the latest editions of the following codes and standards as indicated and applicable.

<u>Sponsor</u>	<u>Title</u>
Clark County	Uniform Standard Specifications for Public Works Construction Off-Site Improvements
Clark County	Supplement to Uniform Standard Drawings and Specifications
OSHA	Occupational Safety & Health Standards

- B. All work shall comply with the latest edition and supplements to the Uniform Standard Specifications for the Public Works' Construction, Off-Site Improvements, Clark County Area, Nevada, and the Uniform Standard Drawings for Public Works' Construction, Off-Site Improvements, Clark County Area, Nevada.
- C. Uniform Standard Specifications for Public Works' Construction, Off-site Improvements, Clark County, Nevada, latest edition.
 - 1. Materials and workmanship specified herein with reference to these Standard Specifications shall be in accordance with the referenced sections, articles and paragraphs except that contractual, measurement, and payment provisions do not apply.
- D. Uniform Standard Drawings for Public Works' Construction Off-site Improvements, Clark County, Nevada, latest edition, and any addenda or supplement thereto.
- E. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- F. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 pound Rammer and 12 inch Drop.
- G. ANSI/ASTM D1556 – Test Method for Density of Soil in Place by the Sand-cone Method.
- H. ANSI/ASTM D1557 – Test Methods for Moisture-Density Relationships of Soils and Soil-Aggregate Mixtures Using 10 pound Rammer and 18 inch Drop.
- I. ASTM D2922 – Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- J. ASTM D3017 – Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.6 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Test Reports – Excavating: Submit the following reports directly to Architect from the testing services, with copy to Contractor.
 - 1. Test reports on borrow material.
 - 2. Field density test reports for Generator Slab on Grade Area and Trenching when wider than 12”.
- C. Sieve analysis results submit under provisions of Section 01 33 00.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Affected utility companies shall be notified at least two working days prior to start of construction.
- B. Should un-charted, or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of engineer and utility owner. Notify Engineer and Architect of conflicts with proposed utilities.
- C. Do not interrupt existing utilities serving facilities occupied and used by Owner or others during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided. Provide minimum of forty-eight (48) hours notice to Architect and Owner and receive written notice to proceed before interrupting any utility.
- D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.
- E. Use of Explosives: The use of explosives is not permitted
- F. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
- G. Operate warning lights as recommended by authorities having jurisdiction.
- H. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

1.8 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the work are as indicated.

1.9 QUALITY ASSURANCE

- A. Contractor shall provide sieve analysis for its stockpiles.
- B. UNLV will be responsible for performance of proctor and in-place density tests for backfilled material.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. Definitions

1. Structural Fill: As documented by Section 32 11 23.
2. Satisfactory soil materials as defined as follows:
 - a. Type I: Pit run, natural stone; free of shale, clay, friable material, sand, debris; graded in accordance with ASTM C136 and as specified in the Uniform Standard Specifications, Clark County, Nevada.
 - b. Type II: Natural stone; free of clay, shale, organic matter; graded in accordance with ASTM C136.
 - c. Type C: Sand - Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, or organic matter; graded in accordance with ASTM C136.
 - d. Subsoil: Reused, imported, free of gravel larger than 3 inch size, and debris, as approved by Soils Engineer/ Structural Engineer and/or Owner.
 - e. Type I Aggregate Base: As specified in Uniform Standard Specifications Section 704.03.02.
 - f. Type II Aggregate Base: As specified in Uniform Standard Specifications Section 704.03.04
 - g. Drain Backfill: As specified in Uniform Standard Specifications Section 704.03.01.
 - h. Selected Backfill: As specified in Uniform Standard Specifications Section 207.02.01.
 - i. Granular Backfill: As specified in Uniform Standard Specifications Section 207.02.02.
3. Base Material: (Under slabs) Type II aggregate base course (ASTM C136) compacted to 95% density of the modified material proctor. Material to conform to requirements of Uniform Standard Specification Section 704, for 1-inch maximum size material.
4. Drainage Fill: Washed, evenly graded mixture of crushed stone or crushed or uncrushed gravel, with one hundred (100) percent passing a 1 ½ inch sieve, and not more than five (5) percent passing a No. 4 sieve.
5. Backfill and Fill Materials: On-site soils conforming to the requirements set forth in the Uniform Standard Specifications Section 207.02.01 and 207.02.02, and minus any debris or organic matter, may be used in required fills. Imported material should be compatible with on-site soils in addition to being suitable for its intended use. All imported materials and backfill materials shall be tested and approved by Soils Engineer/ Structural Engineer and/or Owner prior to importing. Backfill and fill materials should not contain material greater than 6-inches in diameter including oversized material generated by the excavation of cemented soil if encountered during construction. Said material should be selectively hauled off the site or crushed to an acceptable size to be re-placed.
6. Type/gravel base material conforming to requirements of Uniform Standard Specifications, Section 704, for 3-inch maximum size material.
7. Landscape Fill: Material required for restoring existing landscape areas adjacent to the areas where the site work of this renovation is being done. The materials are clean soils free of vegetation, debris and organic contaminants with:
 - a. No refuse, roots, heavy clay, gravel, sticks, brush, litter and other deleterious substances.

- b. Less than ten percent clay content and more than 50 percent sand content.
 - c. No fragment larger than 1 inch in size.
 - d. 100 percent passing a 1 inch sieve.
 - e. 90 to 100 percent passing No. 4 sieve.
 - f. 5 to 60 percent passing No. 16 sieve.
 - g. 0 to 10 percent passing no. 100 sieve.
 - h. Any plant pit filled with water must be able to drain within a 24 hour period.
 - i. Landscape fill requirements only apply to the top two (2) feet of fill of the existing landscape area where the site work is located. Fill areas deeper than two (2) feet may use other fill materials below the landscape fill in accordance with these specifications.
8. Unsatisfactory soil materials are defined as materials not meeting the definitions indicated by this section under 2.1, A, 1 through 6.

PART 3 EXECUTION

3.1 PROTECTION

- A. Actual soils encountered during construction may necessitate that slopes of temporary excavations and trenches be flatter than those indicated on the Drawings. The Contractor shall flatten slopes of temporary excavations and trenches as required for slope stability and safe execution of the work at its own expense.
- B. The Contractor shall be fully responsible for construction of work required for diversion of storm water drainage around or through the construction area.
- C. The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other measures for the removal or exclusion of water, including taking care of storm water and wastewater reaching the site of the work from any source so as to prevent damage to the work or adjoining property. The Contractor shall be responsible for any damage to persons or property due to interruption or diversion of such storm water or wastewater on account of its operations.
- D. Slopes on the sides of excavations shall be such as to insure safe execution of the work. Excavations shall be in accordance with applicable requirements of the Standard Specifications, requirements of OSHA, and with the requirements of the rules, orders, and regulations specified in these Specifications.
- E. Utilities: It shall be the Contractor's responsibility to contact "CALL BEFORE YOU DIG" not less than forty-eight (48) hours prior to starting excavation and to conform to the provisions made by this specification and other related sections, inclusive of Protection of Installed Work.
- F. Protection and Restoration of Surfaces: Protect newly graded areas from traffic, erosion, and settlement. Repair and reestablish damaged eroded slopes, elevations or grades, and restore surface construction prior to acceptance.

3.2 EXCAVATION

- A. Excavation is unclassified and includes excavation to sub-grade elevations indicated, regardless of character of materials and obstructions encountered.

- B. Unauthorized excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction of Soils/ Geotechnical/ Structural Engineer and/or Owner. Unauthorized excavation, as well as remedial work directed by Soils Engineer or Owner, shall be at Contractor's expense.
- C. Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Soils Engineer or Owner.
- D. If unsuitable bearing materials are encountered at required sub-grade elevations, carry excavations deeper and replace excavated material as directed by Soils Engineer or Owner.
- E. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
- F. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
- H. Dust Control: Contractor shall dampen the area of grading and take other measures as required to prevent raising of dust and transportation of same into buildings onto adjacent properties during the duration of the contract in accordance with UNLV, Nevada Public Works and Clark County codes and regulations.
- I. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, shape, and protect stockpiles to ensure proper drainage and avoid erosion.
- J. Locate and retain soil materials away from edge of excavations.
- K. Dispose of excess soil material and waste materials as herein specified.
- L. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 feet and extending a sufficient distance from existing footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and inspection without affecting existing structures.
- M. In excavating close to existing footings and foundations, take care not to disturb bottom of excavation of those existing structural elements. Trim bottoms to required lines and grades to leave solid base to receive other work.
- N. Perform in accordance with Section 203 of the Uniform Standard Specifications and this Section.
- O. Excavation for Pavements (Where and/or If Required): Cut surface under pavements to comply with cross-sections, elevations, and grades in such manner that adjacent re-construction work will work cohesively with existing pavement and its structure.

1. Pavement Section (On-Site):

Material Depth (inches)

Requirements

Automobile Area:

Type III Asphaltic Concrete

Match existing assembly structure OR
2.0 – inches Placed in accordance with
Section 401 of the USSPWC*

Type II Gravel Base

Match existing assembly structure OR
5.0 – inches Placed in accordance with
Section 704.03.04 and Section 302 of
the USSPWC*

Sub-Grade

Reused, imported, free of gravel larger
than 3 inch size, and debris, as
approved by Soils Engineer/ Structural
Engineer and/or Owner.

* "Uniform Standard Specifications for Public Works Construction, Off-Site
Improvements, Clark County Area, Nevada," 1986 Edition, revised/amended.

2. Pavement Section (Off-Site):

Match existing assembly OR Prior to sub-grade placement an R-value will need
to be performed to confirm pavement section per NV Public Works/ Clark County
standards.

3.3 COMPACTION

- A. Control soil compaction during construction providing minimum percentage of density specified elsewhere in this section.
- B. Percentage of Maximum Density Requirements: Compact soil to not less than the percentages of Maximum Dry Density in accordance with ASTM D1557 as specified in this section.
 - 1. Structures, Building Slabs, and Paved Areas: Compact the sub-grade (Type II) and each layer of backfill or fill material (Type I) to minimum 95% recommended maximum density of the modified proctor for the same material for cohesive material or recommended relative compaction for cohesionless material.
 - 2. Lawn or Unpaved Areas: Compact top 6 inches of sub-grade and each layer of backfill or fill material at recommended maximum density for cohesive materials and recommended relative compaction for cohesionless soils. (85-90% of modified proctor of the same material)
 - 3. Walkways: Compact top 4 inches of sub-grade (Type II) imported material to minimum 95% recommended maximum density of the modified proctor for the same material, and each layer of backfill or existing selected fill material below sub-grade at recommended maximum density for cohesive material or recommended relative compaction for cohesionless material (85-90% of modified proctor of the same material).
- C. Moisture Control: Where sub-grade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of sub-grade, or layer of soil material. Apply water in manner to prevent free water appearing on surface during or after subsequent compaction operations.
- D. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

3.4 GROUND SURFACE PREPARATION

- A. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills.
- B. All on-site loose, porous, or dry soils will require removal prior to the placement of fill.
- C. Following removal of un-compacted soils and prior to the placement of fill, scarify the upper 12 inches of the approved ground surface, water, or dry as necessary and re-

compact in accordance with percentages of modified proctor indicated elsewhere in this section. Scarification may be terminated at a shallower depth or omitted if moderately or strongly cemented soil is encountered at the discretion of the Geotechnical Engineer.

- D. All soil and fill material approved by Soils Engineer may be reused in compacted fills.
- E. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 5 horizontal so that fill material will bond with existing surface. Bench and key in accordance with Soils Engineer.
- F. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact depth required in accordance with Soils Engineer recommendations.
- G. Placement and Compaction: Place backfill and fill materials, in layers/ lifts not exceeding 9" in height unless otherwise noted elsewhere in this section; the layer / lift placement is indicated for in loose depth of material that needs to be compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- H. Before compaction, moisten or aerate each layer, as per Soils Report, to provide optimum moisture content. Compact each layer per Soils Report recommendations. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- I. Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

3.5 GRADING

- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.
- B. Grading Outside Site Work Lines: Grade areas adjacent to Site Work lines to drain away from structures and to prevent ponding.
- C. Spread coarse aggregate over prepared base in areas shown on plans.
- D. Place coarse aggregate in layers and compact as specified.
- E. Level and contour surfaces to elevations and grades indicated.
- F. Add quantities of fine aggregate to coarse aggregate as required to obtain compaction specified by Soils Engineer.
- G. Use mechanical vibrating and tamping equipment in areas inaccessible to compaction equipment.
- H. Finish surfaces free from irregular surface changes and as follows:
 - 1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 feet above or below required sub-grade elevations.
 - 2. Walks (If Required): Shape surface of areas under walks to line, grade, and cross section, with finish surface not more than 0.10 feet above or below required sub-grade elevation.

3. Pavements (If Required): Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than ½ inch above or below required sub-grade elevation.
 4. Embankments (if Required): Imported soils for use in embankment construction shall be granular in nature, saline free and exhibit an expansive potential not greater than 4.0 percent
- I. Grading Surface of Fill under Site Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ½ inch when tested with a 10-foot straightedge.
 - J. Compaction: After grading, compact sub-grade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.6 PAVEMENT SUBBASE COURSE

- A. General sub-base course consists of placing structural fill (sub-base) material, in layers of specified thickness, over sub-grade surface to support a pavement base course.
- B. Grade Control: During construction, maintain lines and grades including crown and cross slope of sub-base course.
- C. Placing: Place sub-base course material on prepared sub-grade in layers of uniform thickness, conforming to indicated cross section and thickness. Maintain optimum moisture content for compacting sub-base material during placement operations as Indicated.
- D. When a compacted sub-base course is shown to be 6 inches thick or less, place material in a single layer. When shown to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches in thickness when compacted.

3.7 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed by an independent Geotechnical Engineer under contract with the Owner.
- B. Compaction testing will be performed by an independent Geotechnical Engineer under contract with the Owner.
- C. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no cost to Owner.
- D. Field inspection and testing will be performed under provisions of Section 01 40 00.
- E. Tests for compliance will be made by a representative of the Owner, at the expense of the Owner, using the test procedures specified in Section 111 of the Uniform Standard Specifications and ASTM D1557, unless otherwise indicated.
- F. Field density tests shall be performed in accordance with the test procedures specified in ASTM D1556, ASTM D2922 and ASTM D3017 further detailed herein.
- G. The location and frequency of field tests shall be at the discretion of the Engineer. Sufficient time shall be allotted to the Engineer for performing the necessary control test for acceptance of a compacted layer, before attempting to place new fill material. Any layer, or portion thereof, that does not meet density requirements, shall be reworked and re-compacted until it meets the specified density requirements as determined by the Engineer.

- H. Quality Control Testing During Construction: Allow testing lab/Soils Engineer to inspect and approve sub-grades and fill layers before further construction work is performed.
 - 1. Testing Agency: Shall perform field density tests in accordance with ASTM D1556 (sand cone method) or ASTM D02922 or D3017 (nuclear method), as applicable.
 - 2. Paved Areas and Site Slab Sub-grade: Make at least one field density test of sub-grade for every 200 square feet of paved area or site slab, but in no case less than three tests. In each compacted fill layer, make one field density test for every 200 square feet of overlaying site slab or paved area, but in no case less than three tests.
 - 3. Foundation Wall Backfill (If Required): Take at least two field density tests, at locations and elevations as directed per Soils Engineer.
- I. If, in opinion of Soils Engineer, based on testing service reports and observation, sub-grade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.
- J. Tests made as a result of non-compliance shall be at the Contractor's expense.
- K. Contractor shall provide sieve analysis from its stockpiles prior to construction activities.

3.8 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
- D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (site slabs, pavement, lawn or other finish), add imported and backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match required work, and eliminate evidence of restoration to greatest extent possible.

3.9 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Removal to Designated Areas on Owner's Property: Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil or spread as directed by Soils Engineer or Construction Manager.
- B. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of it off Owner's property at no cost to Owner.

END OF SECTION

SECTION 31 23 16.13

TRENCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation trenches for utilities from 5 feet outside building to connection point.
- B. Compacted bedding under fill over utilities to sub-grade elevations.
- C. Backfilling and compaction.

1.2 RELATED SECTIONS

- A. Section 01 40 00 – Quality Control.
- B. Section 01 45 29 – Testing Laboratory Services: Testing Fill Compaction.
- C. Section 01 50 00 – Construction Facilities and Temporary Controls: Water Control in Excavations.
- D. Section 31 00 00 - Earthwork.
- E. Section 31 23 16.26 – Rock and Caliche Removal.
- F. Section 31 22 16 – Rough Grading.
- G. Section 32 80 00 – Landscape Grading: Filling of Topsoil Over Backfilled Trenches to Finish Sub-Grade Elevation.
- H. Section 31 23 16 – Excavation: General Building Excavation.
- I. Section 31 23 23.13 – Backfilling: General Backfilling.
- J. Section 03 30 00 – Cast-In-Place Concrete: Concrete Materials

1.3 REFERENCES:

- A. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 pound Rammer and 12 inch Drop.
- C. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- D. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 pound Rammer and 18 inch Drop.
- E. ASTM D2922 - Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Method (Shallow Depth).
- F. ASTM D3017 - Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Method (Shallow Depth).
- G. Uniform Standard Specifications for Public Works Construction, Off-site Improvements Clark County Area, Nevada, latest edition and supplements.

- H. Geotechnical Evaluation by Kleinfelder, dated November 14, 2016, project number 20164924.001A.
- 1.4 FIELD MEASUREMENTS
 - A. Verify that survey benchmark and intended elevations for the work are as indicated.
- PART 2 PRODUCTS
- 2.1 FILL MATERIALS
 - A. All imported fill material shall be in accordance with the specifications stated in the Project Soil and Foundation Investigation.
- PART 3 EXECUTION
- 3.1 EXAMINATION
 - A. Verify with the Geotechnical Engineer that excavated materials to be reused for fill are acceptable.
- 3.2 PREPARATION
 - A. Identify required lines, levels, contours, and datum.
 - B. Cut out soft areas of sub-grade not capable of in-situ compaction. Backfill with Type II fill and compact to density equal or greater than requirements for subsequent backfill material.
- 3.3 EXCAVATION
 - A. Excavate subsoil required for all underground utilities.
 - B. Cut trenches sufficiently wide to enable installation of utilities and allow inspection.
 - C. Excavation shall not interfere with normal forty-five (45) degree bearing splay of foundation.
 - D. Excavation shall be trimmed and loose matter removed.
 - E. Correct unauthorized excavation at no extra cost to Owner.
 - F. Correct areas over-excavated by error in accordance with Section 31 23 16.
- 3.4 BEDDING
 - A. Support pipe and conduit during placement and compaction of bedding fill.
- 3.5 FIELD QUALITY CONTROL
 - A. Field inspection will be performed by an independent Geotechnical Engineer under contract with the Owner.
- 3.6 BACKFILLING
 - A. Backfill trenches to contours and elevations with approved materials.

- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy sub-grade surfaces.
- C. Type I and Type II Fill: Place and compact materials in continuous layers not exceeding 6 inches compacted depth.
- D. Structural Fill: Place and compact material as defined in the Project Geotechnical Exploration Report.
- E. Employ a placement method that does not disturb or damage conduit or duct in trench.
- F. Maintain optimum moisture content as defined in the project's soils report.

3.7 TOLERANCES

- A. Top Surface of Backfilling under Paved Areas: Plus or minus one inch from required elevations.
- B. Top Surface of General Backfilling: Plus or minus one inch from required elevations.

3.8 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed by an independent Geotechnical Engineer under contract with the Owner.
- B. Compaction testing will be performed by an independent Geotechnical Engineer under contract with the Owner.
- C. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no cost to Owner.
- D. Frequency of Tests: Per Owner's requirements. Notify Owner's representative when work is ready for testing.

3.9 PROTECTION OF FINISHED WORK

- A. Protect finished work under provisions of Section 01 50 00.
- B. Fills subjected to vehicular traffic shall be re-compacted to achieve the required densities as specified by Geotechnical Engineer.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fence framework, fabric, and accessories.
- B. Manual gates and related hardware.
- C. Installation of fences and gates including excavation and concrete anchorage.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with CLFMI - Product Manual, Manufacturer's instructions, and Uniform Standards.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience with chain link fences and gates.
- B. Installer: Company specializing in installation of the product specified in this section with minimum three (3) years' experience.

1.5 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Framework:
 - 1. Steel pipe conforming to Standard Specification ASTM F1043 Group 1A (Schedule 40).
 - a. External coatings per F1043 type A.
 - b. Internal coatings Type A.
 - 2. High strength steel pipe triple coated per Standard Specification ASTM F1043 Group IC (SS40 as manufactured by Allied Tube & Conduit or approved equal).
 - a. External coating per F1043 Type B.
 - b. External coatings per F1043 Type D.
- B. All coatings to be applied after welding.

- C. Pipe shall be straight , true to section and conform to the following weights:

Pipe Size <u>Outside Diameter</u>	Group Schedule 40 IA <u>Weight lbs./ft.</u>	Group SS40 IC <u>Weight lbs./ft.</u>
1-5/8"	2.27	1.84
1-7/8"	2.72	2.28
2-3/8"	3.65	3.12
2-7/8"	5.79	4.64
3-1/2"	7.58	5.71
4"	9.11	6.56
6-5/8"	18.97	Use sch 40
8-5/8"	29	Use sch 40

- D. Zinc coated fabric:
1. ASTM A392 fabric, 9 gauge-galvanized steel wire, class 1 (1.2 oz. zinc) coated, woven in a 2-inch diamond mesh.
 2. Top and bottom selvage to be knuckled unless otherwise noted.
 3. Provide 1-inch diamond mesh at dumpster gates.
- E. Concrete: As specified in Section 03 30 00, conforming to ASTM C94, Type V, sulfate resistant, having a minimum compressive strength of 4,500 PSI at 28 days.

2.2

COMPONENTS

- A. Fence Posts:

Fabric Height	Line Post O.D.	Terminal Post O.D.
Up to 6'	1-7/8"	2-3/8"
6' to 8'	2-3/8"	2-7/8"
8' to 12'	3-1/2" *	4"

- B. Swing Gate Posts:

Single Gate Width	Double Gate Width *	Post O.D. *
Up to 6'	Up to 12'	2-7/8"
6' to 12'	13' to 24'	4"
12' to 18'	25' to 36'	6-5/8"
Over 18'	Over 36'	8-5/8"

- C. Rails and braces: 1-5/8-inch galvanized steel O.D.

1. Top Rail: Manufacturer's longest lengths, with couplings, approximately 6-inches long, for each joint. Provide means for attaching rails securely to each gate, corner, pull and end post. 1-5/8-inch diameter high strength galvanized steel pipe.
2. Truss Rod: 0.375-inch O.D. hot dipped galvanized steel rod and adjustable tightener.
3. Middle and Bottom Rail:
 - a. If indicated on plans, shall be 1-5/8-inch O.D. galvanized steel pipe.
 - b. Fences 10' or higher shall have a midrail.
 - c. Unless noted on plans, provide tension wire in lieu of bottom rail.

- D. Gates:

1. Frame assembly of 1-7/8-inch galvanized steel O.D. pipe with welded joints. Weld areas repaired with zinc-rich coating applied per manufacturer's directions.
2. Gate fabric to match fence fabric.
3. Gate accessories, three hinges per gate panel (unless otherwise noted), latches, center stops, keepers and necessary hardware of quality required for industrial and commercial application. Latches shall permit padlocking.
4. All personnel gates in fences taller than 7 feet shall have transoms.

5. Chain and lock: Provide a Master Lock (key code: 3303) welded to 30-inches length of 3/8 inch chain welded to the gate frame at approximately the height of the drop latch. Weld shall not interfere with operation of drop latch.
 6. Double Gate Hardware:
 - a. Fork latch with gravity drop, center gate stop and drop rod.
 - b. Three (3) ball and socket type gate hinges per leaf (Master Halco 180 degrees Box Industrial Hinge, no exceptions) and hardware for padlock.
 - c. Industrial malleable iron – galvanized, 180-degree swing hinges are to be used to allow the gate to open fully against the fence so as to be able to lock the gate in the open position with chain and lock.
 7. Single Gate Hardware:
 - a. Single fork latch.
 - b. Three ball and socket type hinges (unless otherwise noted) (Master Halco 180 degrees Box Industrial Hinge, no exceptions) and hardware for padlock. Industrial malleable iron-galvanized.
 - c. 180 degree swing hinges are to be used to allow the gate to open fully against the fence so as to be able to lock the gate in the open position with chain and lock.
 8. Hinges will not have any bolts or other protrusions that could cause injury or catch clothes.
- E. Fittings:
1. Post Caps: Hot dipped galvanized pressed steel or hot dipped galvanized cast iron designed to fit snugly over posts to exclude moisture. Supply dome style caps for terminal posts and loop type for line posts.
 2. Rail and Brace Ends: Pressed steel or cast iron cup-shaped to receive rail and brace end.
 3. Tension Bars: Steel strip, 3/4-inch wide, 1/4-inch thick.
 4. Brace Bands: Pressed steel, 12 gauge thickness 3/4-inch wide.
 5. Tension Wire: Marcellled 7 gauge steel wire with minimum coating of 0.80 ounces of zinc per square foot of wire surface (ASTM A824).
 6. Tie Wires: Steel, 12 gauges.
 7. Hog Rings: Steel wire, 9 gauges, with a minimum zinc coating of 0.80 ounces per square foot of wire surface.

2.3 FINISHES

- A. Components: Galvanized to ANSI/ASTM A123; 1.2 oz./sq.ft. coating.
- B. Fabric: Galvanized, ASTM A392, Class I with not less than 1.2 oz. zinc per sq.ft. of surface.
- C. Hardware: Galvanized to ASTM A153, 1.2 oz./sq.ft. coating.
- D. Accessories: Same finish as hardware.

PART 3 EXECUTION

3.1 INSTALLATION - FENCING

- A. Install framework, fabric, accessories, and gates in accordance with manufacturer's instructions approved shop drawings and in conformance with ASTM F567 for standard fencing and ASTM F969 for Tennis Court Fencing.
- B. General: Installation to conform to the following chart unless otherwise specified on the plans.

Post Diameter

Footing Diameter	$\frac{1\ 7/8''}{12''}$	$\frac{2\ 3/8''}{12''}$	$\frac{2\ 7/8''}{12''}$	$\frac{3\ 1/2''}{14''}$	$\frac{4''}{16''}$	$\frac{6\ 5/8''}{24''}$	$\frac{8\ 8/8''}{24''}$

Height of Post

Footing Depth	$\frac{4'}{30''}$	$\frac{5'}{30''}$	$\frac{6'}{30''}$	$\frac{7'}{33''}$	$\frac{8'}{36''}$	$\frac{9'}{39''}$	$\frac{10'}{42''}$	$\frac{11'}{45''}$	$\frac{12'}{48''}$	$\frac{13'}{48''}$	$\frac{14'}{48''}$	$\frac{15'}{48''}$	$\frac{16'}{60''}$	$\frac{17'}{60''}$	$\frac{18'+}{60''}$

- C. All gate hinges and latch post footings shall be a minimum of 36" deep.
- D. Install framework, fabric, accessories, and gates in accordance with approved shop drawings and contract drawings.
- E. Space line posts at intervals not exceeding 10 feet on center.
- F. Set intermediate, terminal, and gate posts plumb in concrete footings. Slope top of concrete for water runoff.
- G. Provide 8-inch diameter by 12-inch deep concrete footing for center and drop rod retainers at center of double gate openings.
- H. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods.
- I. Provide top rail through line post tops and splice with rail sleeves.
- J. Adjust gates for proper operation, freedom of movement with no binding and lubricate hinges.
- K. Tack weld single gate fork latch assembly to prevent rotation.
- L. Tack weld all double gate drop rod clips to gate frame to prevent rotation.
- M. Do not attach gates to walls; provide gate posts adjacent to walls.
- N. All field welds are to be cleaned and painted with galvanized paint.

3.2 **INSTALLATION – FABRIC**

- A. Place fabric on outside posts and rails.
- B. Do not stretch fabric until concrete foundation has cured.
- C. Strength fabric between terminal posts to provide a taut fence.
- D. Position bottom of fabric 1-1/2-inch to 2-inch maximum above finished grade.
- E. Fasten fabric to top rail, line posts, braces, stretcher bars with tie wire and bottom tension wire with hog rings ever 18-inch.
- F. Attach fabric to end, corner and gateposts with tension bars and tension bar clips.
- G. Install bottom tension wire stretched taut between terminal posts.

3.3 CONSTRUCTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4-inch.
- B. Maximum Offset from True Position: 1-inch.
- C. Components shall not infringe on adjacent property lines.

3.4 COMPLETION

- A. The area of installation shall be left free of debris caused by the installation of the fence.
- B. Clean dirt and debris from drop latch post holes.
- C. Remove cement from all fence and net posts.

END OF SECTION

UNLV EPA QAL RENOVATION SPECIFICATIONS

DIVISION 22 – PLUMBING

22 05 00.....	Plumbing General Requirements
22 05 23.....	General Duty Valves for Plumbing Piping
22 05 29.....	Hangers and Supports for Plumbing Systems
22 05 53.....	Identification for Plumbing Piping and Equipment
22 07 00.....	Plumbing Insulation
22 11 16.....	Domestic Water Piping
22 11 19.....	Domestic Water Piping Specialties
22 11 26.....	Facility Natural Gas Piping
22 13 16.....	Sanitary Waste and Vent Piping
22 13 19.....	Sanitary Waste Piping Specialties
22 63 13.....	Gas Piping For Laboratory

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

23 05 00.....	Mechanical General Requirements
23 05 13.....	Common Motor Requirements for HVAC Equipment
23 05 29.....	Hangers and Supports for Mechanical Systems
23 05 48.....	Vibrations and Seismic Controls for HVAC Equipment
23 05 53.....	Identification for HVAC Equipment
23 05 93.....	Testing, Adjusting and Balancing
23 07 00.....	HVAC Insulation
23 21 14.....	Condensate Drain Piping
23 23 00.....	Refrigerant Piping and Specialties
23 31 13.....	Metal Ducts
23 33 00.....	Air Duct Accessories
23 33 10.....	Air Duct Cleaning
23 34 16.....	Centrifugal HVAC Fans
23 37 13.....	Diffusers, Registers and Grilles
23 41 00.....	Particulate Air Filtration
23 51 13.....	Draft Control Devices
23 81 26.....	Split System Air Conditioners

END OF SPECIFICATION INDEX

SECTION 22 05 00

PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures.
- F. "Provide" and "Install" means item with all appurtenances, shall be furnished and installed by contractor unless otherwise is directed in the drawings.
- G. Examples include installations within unheated shelters.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.

4. Escutcheons.

B. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- D. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.
- E. Mark dimensions and values in units to match those specified.
- F. Submit miscellaneous items specified on the drawings but not covered in the specifications. Make no substitutions without prior approval from the Engineer.\

1.06 REGULATORY REQUIREMENTS

- A. Requirements of Regulatory Agencies:
 - 1. ASME Boiler Pressure Vessel Codes, Section VII, Pressure Vessels; Section IX, Welding Qualifications.
 - 2. ASHRAE.
 - 3. UL Publications.
 - 4. ASTM.
 - 5. ANSI B31.1, "Code for Pressure Piping".
 - 6. TEMA.
 - 7. OSHA.
 - 8. EPA.
 - 9. ARI.
 - 10. NFPA.
 - 11. UMC.
 - 12. UPC.
 - 13. IBC

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.08 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Deliver products in the manufacturer's original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.
- B. UNLV P.M. may require removal from the premises of such material or Work that in his opinion is not in accordance with Contract Documents. He may also require substitution, without delay, of unsatisfactory Work.
- C. Repair and refinish work damaged by the Work of this Division, to UNLV P.M.'s satisfaction. Obtain finishing materials from equipment manufacturer.

2.02 MANUFACTURERS (All pipe and accessories shall be manufactured in the U.S.A.).

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.03 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.04 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- 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.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze

- flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.05 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 inches and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 inches and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Above ground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics.

2.06 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Eclipse, Inc.
 - c. Epco Sales, Inc.
 - d. Hart Industries, International, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Epco Sales, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.07 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Thunderline
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.08 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.

2.09 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 EXCAVATION AND BACKFILL

- A. General: Excavation and backfill, if required to install the Work specified in this Division shall be performed in compliance with the following requirements.

- B. Excavation: Bury piping outside the building to a depth of not less than 2'-6" below finish grade unless noted otherwise.
- C. Backfilling: Do not backfill until final inspection and approval for the piping installation by the UNLV Inspection Services.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.

- h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Thermal and Moisture Protection" for materials and installation.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.

- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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 unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.06 MECHANICAL INSTALLATIONS

- A. The requirements of this Section apply to all the Work of Division.
- B. It is the intention of the Contract Documents including Specifications and Drawings to provide finished Work, tested and ready for operation and complete in every regard. Provide Work not shown or specified and accessories necessary to make the Work shown on the Drawings complete and ready for operation. Should there appear to be discrepancies or questions of intent in the Contract Documents, refer the matter to the UNLV P.M. for his decision. The decision of the UNLV P.M. is final.
- C. Drawings are diagrammatic and are intended to convey scope of Work and to indicate general arrangement. They are not intended to show every detail including offset or fitting or every structural difficulty that may be encountered during the Work. Except as otherwise indicated, locations of items are approximate only. Exact locations necessary to secure proper conditions and results must be determined at Project Site and must be approved by the Owner. Do not scale Drawings.
- E. Except as otherwise indicated, make only approved modifications in layout as needed to prevent conflict with other Work or for proper execution of Work.
- F. Include Work not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in Work.

3.07 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

- C. Field Welding: Comply with AWS D1.1.

3.09 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

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. Bronze ball valves.
 - 2. Bronze swing check valves.
 - 3. Plug valves.
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 4. Set butterfly valves closed or slightly open.
 - 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES (valves shall be manufactured in the USA)

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Butterfly Valves: With extended neck.
- E. Valve-End Connections:
 - 3. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 4. Grooved: With grooves according to AWWA C606.
 - 5. Solder Joint: With sockets according to ASME B16.18.
 - 6. Threaded: With threads according to ASME B1.20.1.
- F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Apollo Valve Company.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.

- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Stainless Steel
- j. Port: Full.

2.3 BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
- B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DeZurik Water Controls.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.

2.4 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.5 PLUG VALVES

- A. Class 125, Regular-Gland, Plug Valves with Threaded Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - b. DeZurik
 - c. Homestead
 - d. Lunkenheimer
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.

- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron or bronze
- d. Pattern: Regular or short.
- e. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: ball or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where

- solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Two piece, full port, bronze with stainless steel, Ball.
 3. Bronze Swing Check Valves: Class 150, bronze disc.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system
- B. piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
- C. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.05 SUBMITTALS

- A. Product Data: For the following:

1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
 3. Pipe positioning systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Pipe stands. Include Product Data for components.
 4. Equipment supports.
- C. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
 2. AWS D1.2, "Structural Welding Code--Aluminum."
 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

2.02 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. Carpenter & Paterson, Inc.
 3. Grinnell Corp.
 4. National Pipe Hanger Corporation.
 5. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.04 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Thomas & Betts Corporation.
 - 3. Tolco Inc.
 - 4. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.05 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. Pipe Shields, Inc.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

2.06 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type **zinc-coated** steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Hilti, Inc.

2.07 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

2.08 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.09 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, Nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 to allow off-center closure for hanger installation before pipe erection.
 - 4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 - 8. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): for suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 - 9. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 - 10. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30
 - 11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

12. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 if longer ends are required for riser clamps.
 3. Support all vertical piping with wrought steel riser clamps at every floor.
 4. Support all vertical piping independent of horizontal piping.
 5. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp-end extension from inserts.
 6. Support all vertical pipes that penetrate the roof deck with unistrut attached to framing member, not deck. The pipe will be supported at the roof deck just below the deck and also minimum 24" below deck with unistrut to prevent rotational movement.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping System Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 5. C-Clamps (MSS Type 23): For structural shapes.
 6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 10. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 11. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.

- c. Heavy (MSS Type 33): 3000 lb.
- 12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1- 1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
 - 3. Hang pipe from primary building structure. Piping shall not be hung from other piping. All rigid hangers shall provide a means for vertical adjustment after erection.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install Additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 SUBMITTALS

Product Data: For each type of product indicated.

- A. Samples: For color, letter style, and graphic representation required for each identification material and device.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B Coordinate installation of identifying devices with locations of access panels and doors.
- C Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches and proportionately larger

lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. Fasteners: Stainless-steel rivets or self-tapping screws.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with

lettering indicating service, and showing flow direction.

- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 2. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.
 - 2. Provide framed/laminated valve chart(s) at wall near equipment.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Provide red ceiling tacks $\frac{3}{4}$ " Diameter to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - c. Natural Gas: 1-1/2 inches, round.
 - 2. Valve-Tag Color:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.

- c. Natural Gas: Natural.
- 3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.
 - c. Natural Gas: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Cellular glass.
 - b. Mineral fiber.
 - c. Polyisocyanurate.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Field-applied jackets.
 - 9. Tapes.
 - 10. Securements.
 - 11. Corner angles.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application at linkages of control devices.
 - 7. Detail field application for each equipment type.
- C. Qualification Data: For qualified Installer.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- E. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- B. Store insulation in original wrapping and protect from weather and construction damage.

1.06 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 – PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foam glass Super K.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- I. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the

following:

- a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000(Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi-rigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- K. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Apache Products Company; ISO-25.
 - b. Dow Chemical Company (The); Trymer.
 - c. Duna USA Inc.; Corafoam.
 - d. Hi Therm
2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
- a. Pipe Applications: ASJ.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Childers Products, Division of ITW; CP-96.
 - 2. Foster Products Corporation, H. B. Fuller Company; 81-33.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Design Polymenics
 - d. Ductmate Industries
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.06 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Pittsburgh Corning Corporation; Pittseal 444.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.07 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according

to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.08 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Johns Manville; Zeston.
- b. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

- C. Metal Jacket:

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

- a. Childers Products, Division of ITW; Metal Jacketing Systems.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

- a. Factory cut and rolled to size.

- b. Factory-Fabricated Fitting Covers:

- 1) Same material, finish, and thickness as jacket.

- 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
- 3) Tee covers.
- 4) Flange and union covers.
- 5) End caps.
- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.

5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
- M. Draw jacket tight and smooth.
- N. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
- O. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
- P. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
- Q. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- R. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- S. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- T. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- U. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.04 **PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in Division 07 Section "Thermal and Moisture Protection" firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Thermal and Moisture Protection".

3.05 **EQUIPMENT INSULATION INSTALLATION**

- A. Insulation Installation on Pumps:
 1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively,

- secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.050 inch thick.

3.06 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.07 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

- A. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
- B. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
- C. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
- D. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.08 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
- C. Install pipe insulation to outer diameter of pipe flange.
- D. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
- E. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
- F. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- G. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- H. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.09 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus

- twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.10 POLYISOCYANURATE INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.
- C. Insulation Installation on Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of polyisocyanurate insulation to valve body.
 2. Arrange insulation to permit access to packing and to allow valve

- operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot/Tempered and Recirculated Hot Water:
 1. Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I:

TABLE 22 07 00-A
PIPE INSULATION SCHEDULE
INSULATION THICKNESS FOR NOMINAL PIPE SIZES

<u>SYSTEM</u>	<u>TEMP. RANGE</u>	<u>1 AND LESS IN.</u>	<u>1-1/4 TO 2 IN.</u>	<u>2-1/2 TO 4 IN.</u>	<u>6 AND UP IN.</u>	<u>JACKET</u>
Hot/Tempered Water Domestic	90-200	1.0	1.0	1.5	--	All Service
Hot/Tempered Water Return Domestic	90-200	1.0	1.0	--	--	All Service
Cold Water Domestic, Non-Conditioned Areas	Any	1.0	1.0	1.5	--	All Service

NOTE: All insulation exposed to weather shall be provided with aluminum covering.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
 - 1. PVC 30 mils thick.

TABLE 22 07 00-B
VALVE AND FITTING JACKET SCHEDULE

<u>SYSTEM</u>	<u>LOCATION</u>	<u>JACKET</u>
Hot/Tempered Water Domestic	All Concealed	Glass Cloth And Adhesive Or Premolded
Hot/Tempered Water Domestic	All Exposed	Premolded Cover Interior Only
Cold Water Domestic Non-Conditioned Areas	All Exposed	Premolded Cover Interior Only
All Exterior Piping	All Exposed	Rigid Insulation with Full Metal Jacket

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Encasement for piping.
 - 3. Specialty valves.
 - 4. Flexible connectors.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Wall penetration systems.

1.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to the IBC.

1.04 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Backflow preventers.
 - 6. Escutcheons.
 - 7. Sleeves and sleeve seals.

1.05 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.06 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.07 DELIVERY STORAGE AND PROTECTION

- A. Division 1 - Material and Equipment: Transport, handle, store, and protect products.

- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 – PRODUCTS

2.01 PIPING MATERIALS (all pipe and fitting shall be manufactured in the U.S.A.)

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

2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.03 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, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.04 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Sheet or Tube.
- C. Material: LLDPE film of 0.008-inch minimum thickness.
- D. Color: Black or Natural.

2.05 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.06 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.07 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hart Industries International, Inc.
 - b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - c. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - 2. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig (1035 kPa), 175 psig (1200 kPa) minimum, 300 psig (2070 kPa) as required for the project.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.08 FLEXIBLE CONNECTORS

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

1. Flexicraft Industries.
 2. Hyspan Precision Products, Inc.
 3. Metraflex, Inc.
 4. Proco Products, Inc.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig, 250 psig as required.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig, 250 psig as required.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.09 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- E. One-Piece Floor Plates: Cast-iron flange.
- F. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.10 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with setscrews.

2.11 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Thunderline.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 – EXECUTION

3.01 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install shutoff valve immediately upstream of each dielectric fitting.
- C. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- D. Install domestic water piping level and plumb.
- E. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping adjacent to equipment and specialties to allow service and maintenance.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages. (Unless otherwise specified on drawings).
- P. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

3.03 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.
- E. Locate valves for easy access and operation; where concealed, access doors shall be provided. Coordinate requirements with Prime Contractor.

- F. Do not locate valves with stems below horizontal.

3.05 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

3.06 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.07 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump. (Unless otherwise specified on drawings.)
- B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.08 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.09 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls. (wrap un-insulated copper pipe through ferrous sleeves or in contact with concrete with protective tape)
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 "Thermal and Moisture Protection" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 "Thermal and Moisture Protection" for joint sealants.

- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using wall penetration systems specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 "Thermal and Moisture Protection" for flashing.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 "Thermal and Moisture Protection" for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.14 TEST/FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 5. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. The following tests shall be made in the presence of the UNLV Inspection Services and the UNLV Project Manager. Forty-eight (48) hours notification shall be made prior to tests.
- G. Potable Water and Industrial Water Piping Leakage Test:
 - 1. General: After completion of the Work, but before final, acceptance is made, run a test over a four hour period of time to prove that the capacity and performance of all apparatus fittings and the system as a whole meets the requirements of the specifications.
 - 2. Pressure Tests: Start and complete pressure tests in the presence of the UNLV Inspection Services.
 - 3. Cold and hot water services within the Building shall be tested at 120 psi for a period of 4 hours. Any joints showing visible leakage shall be cut out and remade; opening of joints shall not be permitted. Retest sections of pipework containing remade joints.

3.15 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.16 CLEANING

- A. Clean and disinfect potable service entrance piping and water distribution piping as follows:
 1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for 3 hours.
 - c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.
- B. Prepare and submit reports for purging and disinfecting activities.
- C. Clean interior of piping system. Remove dirt and debris as work progresses.
- D. The contractor is required to perform the flushing and disinfection of the cold and tempered water loops in every phase of work.
- E. During each phase of construction when the water supply system is open for remodel the contractor must flush and disinfect the system per Specification 221116, Paragraph 3.16 at the end of work in that phase.
- F. Prepare and submit reports of purging and disinfecting activities.
- G. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.17 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L wrought- copper solder-joint fittings; and soldered joints.
- D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L wrought- copper solder-joint fittings; and soldered joints.

3.18 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball for piping NPS 2 1/2 and smaller. Use butterfly, ball, with flanged ends for piping NPS 3".
 - 2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Balancing valves.
 - 2. Temperature-actuated water mixing valves.
 - 3. Strainers.
 - 4. Hose bibbs.
 - 5. Drain valves.
 - 6. Water hammer arresters.
 - 7. Trap-seal primer valves.

1.03 EXPANSION TANK (DET) AS SPECIFIED IN THE DRAWINGS

Closed, welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code, 125 psi rating, cleaned, prime coated, and supplied with steel support saddles, with tapings for installation of accessories. Tank shall be precharged with replaceable heavy duty Butyl Rubber Diaphragm.

1.04 ELECTRICAL WATER HEATER (EWH)

- A. Electric water heater as specified on the Drawings.

1.05 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. 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.

PART 2 – PRODUCTS

2.01 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. ITT Industries; Bell & Gossett Div.
 - c. NIBCO INC.
 - d. Taco, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: bronze,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.02 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leonard Valve Company.
 - b. Powers; a Watts Industries Co.
 - c. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature- control handle.
8. Valve Finish: Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - d. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Cabinet-type, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Valve Finish: Polished, chrome plated.
10. Piping Finish: Chrome plated.
11. Cabinet: Factory-fabricated, stainless steel, for mounting as indicated and with hinged, stainless-steel door.

2.03 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch
 - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.04 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

B. Washing Machine Wall Boxes:

1. Acceptable Manufacturers: Guy Gray, Oatey and Acorn
2. Plastic or epoxy coated steel recessed wall box with face flange, overflow lip, fastening tabs, 1/2" or 1/4" (refer to drawings) hot and cold bronze washing machine angle shutoff valves rated for 125 psi and 180 degrees F, long shank valve fittings for replacement of valves within box, 2" drain outlet fitting (where shown on the drawings).

2.05 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.06 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. PPP Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.07 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. PPP Inc.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

- F. Install water hammer arresters in water piping according to PDI-WH 201.
- G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- H. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- I. Washing Machine Boxes:
 - 1. Install in wall construction, secured to structure, directly behind proposed washing machine location.
 - 2. Provide water hammer arrestors at domestic water connections.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.03 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Calibrated balancing valves.
 - 2. Primary, thermostatic, water mixing valves.
 - 3. Supply-type, trap-seal primer valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.04 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 11 26

FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Pipes and fittings.
 - 2. Piping specialties.
 - 3. Piping joining materials.
 - 4. Valves.
 - 5. Pressure regulators.
 - 6. Service meters.
 - 7. Mechanical sleeve seals.
 - 8. Grout.
 - 9. Concrete bases.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.04 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 3. Pressure regulators. Indicate pressure ratings and capacities.
 - 4. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars and supports.
 - 5. Dielectric fittings.
 - 6. Mechanical sleeve seals.
 - 7. Escutcheons.
- B. Welding certificates.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For motorized gas valves, pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER'S

- 1. Metallic Gas Pipe (ASTM A53): Wheatland Tube; Valencia Pipe Company; SAHA Thai Steel Public Co. LTD.
- 2. Fuel Gas Pipe Fittings: SCI (Smith Cooper); Viega LLC – Press-connect Metallic fittings; BIS Pipe; Jinan; Charman Manufacturing – Malleable Fittings classes 150 and 300.
- 3. Gas Valves: Stockham, Homestead; Nordstrom; Crane; Rockwell; Mueller; Rockford-Eclipse; Lunkenheimer.

2.02 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.02 PIPING SPECIALTIES

- A. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 1. Copper-alloy convenience outlet and matching plug connector.

2. Nitrile seals.
 3. Hand operated with automatic shutoff when disconnected.
 4. For indoor or outdoor applications.
 5. Adjustable, retractable restraining cable.
- B. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.03 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 MANUAL GAS SHUTOFF VALVES

- A. 2" and smaller: Bronze or ferrous body, threaded ends, bronze or ferrous tapered plug. 150 psi W.O.G., for use as natural gas shut-off.
- B. 2-1/2" through 4": Cast iron body, flanged ends, bronze bearings, electroless nickel plated cast iron plug with Hycar resilient plug seal, Buna-N stem seal packing, lever actuator, 175 psi W.O.G., for use as natural gas shut-off.
- C. Provide plug valves for all installations.

2.05 Gas Pressure Regulators: ANSI Z21.18 or ANSI Z21.18a, single stage, steel jacketed, corrosion-resistant pressure regulators. Include atmospheric vent, elevation compensator, with threaded ends for 2 inches and smaller and flanged ends for 2 inches and larger. Regulator pressure ratings, inlet and outlet pressures, and flow volume in standard cubic feet per hour of natural gas at specific gravity are as indicated:

1. Acceptable Manufacturer's: Equimeter, Fisher, Maxitrol, or equal.
2. Line Gas Pressure Regulators: Inlet pressure rating not less than system pressure.
3. Appliance Gas Pressure Regulators: Inlet pressure rating not less than system pressure, with capacity and pressure setting matching appliance.
4. Gas Pressure Regulator Vents: factory or field installed corrosion-resistant screen in opening when not connected to vent piping.
5. Flexible Connectors: Not Acceptable.

2.06 DIELECTRIC FITTINGS

- A. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - f. Wilkins; Zurn Plumbing Products Group.
 2. Minimum Operating-Pressure Rating: 150 psig.
 3. Combination fitting of copper alloy and ferrous materials.
 4. Insulating materials suitable for natural gas.
 5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain,

or welded end connections that match piping system materials.

2.07 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.08 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thunderline.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.09 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Cast-Brass Escutcheons: With set screw.
 - 1. Finish: Polished chrome-plated.
- C. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- D. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
- E. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.11 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for natural gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect gas piping according to Plumbing Code and NFPA 54 to determine that gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.03 OUTDOOR PIPING INSTALLATION

- A. Comply with Plumbing Code and NFPA 54 for installation and purging of gas piping.
- B. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.
- C. Install fittings for changes in direction and branch connections.
- E. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
- F. Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- H. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 22 Section "Meters and Gages for HVAC Piping."
- I. Street elbows, bushings, and long screw fittings will not be allowed.

3.04 INDOOR PIPING INSTALLATION

- A. Comply with Plumbing Code and NFPA 54 for installation and purging of gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install escutcheons at penetrations of interior walls, ceilings, and floors.
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - d. Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - e. Piping in Equipment Rooms: One-piece, cast-brass type.
 - f. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- M. Verify final equipment locations for roughing-in.
- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- R. Concealed Location Installations: Except as specified below, install concealed gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap. (Unless otherwise specified on drawings).
 - 1. Above Accessible Ceilings: gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 - 3. Prohibited Locations:

- a. Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install gas piping in solid walls or partitions.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down. Street fitting and bushing shall not be acceptable.
- T. Connect branch piping from top or side of horizontal piping.
- U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- V. Do not use gas piping as grounding electrode.
- W. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."
- X. Street elbows, bushings, and long screw fittings will not be allowed.

3.05 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.06 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints for Low Pressure Service:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.07 HANGER AND SUPPORT INSTALLATION

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch .
3. NPS 1-1/2 and NPS 2: Maximum span, 08 inches minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

3.08 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.09 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.10 PAINTING

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel.
 - d. Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex.
 - d. Color: Gray.
 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd.
 - d. Color: Gray.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge gas according to Plumbing Code and NFPA 54 and authorities having jurisdiction.
- C. Gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.14 OUTDOOR PIPING SCHEDULE

- A. Aboveground gas piping shall be one of the following:
 - 1. Steel pipe with wrought-steel fittings and /or welded joints.
- B. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:
 - 1. Steel pipe with wrought-steel fittings and /or welded joints.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

- A. Aboveground, branch piping NPS 1 and larger shall be one of the following:
 - 1. Steel pipe with wrought steel fittings and welded joints malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:
 - 1. Steel pipe with wrought-steel fittings and /or welded joints.

3.17 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
 - 1. Bronze or ferrous body plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
 - 1. Bronze or ferrous body plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 - 1. Bronze or ferrous body plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2) and larger shall be one of the following:

1. Bronze plug valve.
2. Cast-iron, plug valve.

E. Valves in branch piping for single appliance shall be the following:

1. Bronze or ferrous plug valve.

F. Gas Piping Leakage Test:

1. All fuel gas piping shall be tested to 60 psig, compressed nitrogen, for three hours, without notice of pressure drop.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. PE: Polyethylene plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. TPE: Thermoplastic elastomer.

1.04 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to IBC.

1.05 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
- C. Field quality-control inspection and test reports.

1.06 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.
PVC DWV pipe must be solid wall, not cellular core.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. (all pipe and fittings shall be manufactured in the U.S.A.)

2.02 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Heavy Duty, Type 304 Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 - b. Laboratory Waste and Vent Pipe
 - 1) Orion
 - 2) Zurn Chemical Drainage Group

2.04 LABORATORY DRAINAGE (AW AND AV) SYSTEM

- A. Underground/ aboveground Laboratory Piping: Install polypropylene pipe with mechanical joints and/or electrical fusion joints per manufacturer's recommendations. Pipe material shall be UL, NSF, IAPMO listed and meet requirements of UL-94-VO(non-combustible/ flame retardant), Fire Marshall for fire spread/ smoke development rates, when installed above grade. Piping shall match existing approved materials.

2.05 PVC SCHEDULE 40 SOLID WALL PIPE AND DWV FITTING SYSTEM

- A. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall

be iron pipe size (IPS) conforming to ASTM D 1785 and ASTM D 2665. Fittings shall conform to ASTM D 2665.

- B. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Testing with compressed air or gas may result in injury or death. Solvent cements shall conform to ASTM D 2564. Primer shall conform to ASTM F 656. The system to be manufactured by Charlotte Pipe and Foundry Co. and is intended for non-pressure drainage applications where the temperature will not exceed 140 degrees F.

PART 3 – EXECUTION

3.01 EXCAVATION

- A. Refer to Division 31 Section for excavating.

3.02 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil, waste piping and vent piping shall be the following:
 - 1. 1-1/2-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - 2. 1-1/4- and 1-1/2-Inch NPS: Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
 - 3. 2- to 4-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - 4. 2- to 4-Inch NPS: Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
- C. Underground, soil, waste, and vent piping shall be the following:
 - 1. 1-1/2-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - 2. 1-1/2- Inch NPS: PVC plastic pipe, solid wall only. Foam core or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14.
 - 3. 2- to 4-Inch NPS: Hub-less, cast-iron soil pipe, hub-less, cast-iron, soil-pipe fittings,
 - 4. 2-to4- Inch NPS: PVC plastic pipe, solid wall only. Foam core or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints. Pipe and fitting shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14.
 - 5. 2- to 4-Inch NPS: PVC plastic pipe, solid wall only. Foam or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints.
 - 6. 5-and 6-Inch NPS: PVC plastic pipe, solid wall only. Foam core or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints. Pipe and fitting shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with national Sanitation Foundation (NSF) standard 14.
 - 7.

3.03 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- L. Install PVC soil and waste drainage and vent piping according to UPC/IAPMO standards.
- M. Install underground PVC soil and waste drainage piping according to UPC/IAPMO standards.
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.

- I. Install supports for vertical steel piping every 15 feet.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main or sanitary manhole.

3.07 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain

constant without introducing additional air throughout period of inspection.

Inspect plumbing fixture

connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.08 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Miscellaneous sanitary drainage piping specialties.

1.03 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that grease interceptors, grease removal devices, oil interceptors, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- 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.

1.06 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 – PRODUCTS

2.01 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Outlet Connection: Threaded.
7. Closure: Brass plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to clean out.
13. Standard: ASME A112.3.1.
14. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.

2.03 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Grease Interceptor (GI) and Sample Chamber

1. Material: Precast concrete.
2. Rough-in: Fully recessed deep rough-in, manholes shall be flush with floor.
3. Accessories: Multi-weir baffle assembly, integral deep seal trap, removable integral flow control.
4. Cover: Steel, epoxy coated, with gasket, securing handle, and enzyme injection port.
5. Unit Rating: See plans
6. Manufacturer: See plans

2.05 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- K. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- L. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.03 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. 0.0625-inch thickness or thinner.
 2. Copper Sheets: Solder joints of copper sheets.

- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Flashing and Sheet Metal".
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Solids interceptors.

3.05 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system 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.

3.06 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 63 13

GAS PIPING FOR LABORATORY

PART 1 -GENERAL

1.1 SUMMARY

- A. Work under this section of the specification shall consist of providing all labor, material, and equipment necessary for the complete and satisfactory installation of laboratory cylinder gas piping systems in accordance with the Contract Documents.
- B. Laboratory cylinder gas systems include the following listed gases:

Lab Vacuum

1.2 RELATED DOCUMENT

- A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 specifications sections apply to work in this section.

PART 2 -PRODUCTS

2.1 S.S. PIPING SYSTEMS

- A. All listed cylinder gas except acetylene shall be piped in fully annealed, seamless, stainless steel tubing ASTM A-213 type TP-316 with a hardness not to exceed Rc 90. Tubing shall be free of scratches.
 - 1. Wall thickness shall be not less than:

<u>Tubing Size</u>	<u>Wall Thickness</u>
1/4	.035
5/16	.049
3/8	.049
1/2	.065
5/8	.083
3/4	.083
 - 2. Fittings shall be Swagelok or approved equal, double ferrule tube fittings. Pressure rating for the entire piping system for tubing 1/4" and smaller shall be greater than 4000 psig.
 - 3. All listed cylinder gas tubing and fittings shall be factory cleaned and sealed in accordance with specifications for "Oxygen Clean Piping".

2.2 GAS PRESSURE REGULATORS-CYLINDER GAS MANIFOLD

- A. High purity horizontal manifold shall be Airco Model S71, or equal.
- B. Manifold shall include:
 - 1. P & T Relief Valve.
 - 2. Manifold Header.
 - 3. Station Valves.
 - 4. Pigtailes with Check Valves and Handles.
 - 5. "L" Brackets for Wall Mount.
- C. Automatic switchover station shall be similar to Airco model S69-100/500 in stainless steel.

- D. Furnish unit with a pressure alarm to indicate when a switchover has been accomplished (if gas is flammable, unit shall be explosion proof).

2.3 GAS PRESSURE REGULATORS

- A. Provide high purity gas pressure regulators as shown on the drawings.

PART 3 -EXECUTION

3.1 INSTALLATION

- A. Piping, valves and station regulators as indicated shall be furnished and installed under this section. Piping shall terminate at the gas supply area with a valve and cap as shown on drawings. Cylinders will be Owner furnished and Owner installed.
- B. All joints in the tubing, except those at valves or equipment requiring screwed connections, shall be made of Swagelok fittings. Suitable adapters shall be used for installation of valves and other equipment provided with threaded connections.
- C. Screwed joints made for attaching vales or other permanently connected equipment shall be installed by tinning the male thread with soft solder before assembly. The tinning must provide thorough coverage of the threads and the joint must be taken up a sufficient number of turns to provide normal thread engagement. Where heating is required to effect proper assembly, adequate precautions must be taken to avoid damage to the valve or equipment to overheating. Do not use any compound such as pipe dope, shite lead, etc., on screwed joints. Teflon tape shall be used.

3.2 CLEANING

- A. Gas systems are high purity systems. Cleaning shall be necessary to obtain the required gas quality. Piping, fittings and valves shall be factory cleaned to standards required for medical oxygen type piping and shall be sealed before shipment from the factory.
- B. Before erection, all tubing, valves and fittings shall be thoroughly cleansed of oil, grease, dirt or other contaminating materials by washing in a hot solution of sodium carbonate or trisodium phosphate mixing the proportions of 1 pound to 3 gallons of water. Scrubbing shall be employed where necessary to obtain complete cleaning. After washing materials shall be rinsed thoroughly with clean water and dried with dry nitrogen. After clean all tubing, fittings, and valves shall be plugged or wrapped during storage and transported to the location site. Particular care must be exercised in the handling of all material and conditions of tools used in cutting or reaming to prevent oil and grease being introduced into the pipe, tube, or fitting. Where such contamination has occurred, the items affected must be rewashed.

3.3 TESTING

- A. All piping shall be tested. Piping shall be tested for systems of maximum purity. The Contractor shall employ preliminary pressure tests outlined below.
- B. After erection of the tubing, but before installation of outlet valves, the line shall be blown clear by means of dry nitrogen.
- C. After installation of outlet valves, each section shall be subject to a test pressure of at least 1-1/2 times the maximum working pressure, but not less than 50 pounds per square inch by means of dry nitrogen. This test pressure shall be maintained until each joint has been examined for leakage by means of Oxweld No. 23 Leak Test Solution or other nonfrothing solutions approved for this purpose.

- D. After completing the joint test, a final check for leakage shall be made by allowing the pressure to remain in the piping for at least 24 hours. This test shall include measurement of the temperature of the piping at the beginning and end of the test for accurately evaluating the relation of final initial pressures as a measure of the leak tightness of the piping. No pressure changes, other than that caused by temperature change, will be permitted.

END OF SECTION

SECTION 23 05 00

MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - 9. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

- H. "Provide" and "Install" means item with all appurtenances, shall be furnished and installed by contractor unless otherwise is directed in the drawings.

1.04 SUBMITTALS

- A. Product Data: For the following:
1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
- B. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.
- D. Mark dimensions and values in units to match those specified.
- E. Submit miscellaneous items specified on the drawings but not covered in the specifications. Make no substitutions without prior approval from the Engineer.

1.06 REGULATORY REQUIREMENTS

- A. Requirements of Regulatory Agencies:
1. ASME Boiler Pressure Vessel Codes, Section VII, Pressure Vessels; Welding Qualifications.
 2. ASHRAE.
 3. UL Publications.
 4. ASTM.
 5. ANSI B31.1, "Code for Pressure Piping".
 6. TEMA.
 7. OSHA.
 8. EPA.
 9. ARI.
 10. NFPA.
 11. UMC.
 12. UPC.
 13. IBC

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.08 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Deliver products in the manufacturer's original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.
- B. UNLV P.M. may require removal from the premises of such material or Work that in his opinion is not in accordance with Contract Documents. He may also require substitution, without delay, of unsatisfactory Work.
- C. Repair and refinish work damaged by the Work of this Division, to UNLV P.M.'s satisfaction. Obtain finishing materials from equipment manufacturer.

2.02 MANUFACTURERS (All pipe and accessories shall be U.S.A. manufactured).

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.03 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.04 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.05 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.06 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Thunderline.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.08 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated

- finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- L. Sleeves are not required for core-drilled holes.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. of mechanical equipment areas or other wet areas 2 inches a Exception: Extend sleeves installed in floors above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Pipe Sleeves: For pipes smaller than NPS 6.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

3.03 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.05 MECHANICAL INSTALLATIONS

- A. The requirements of this Section apply to all the Work of Division.
- B. It is the intention of the Contract Documents including Specifications and Drawings to provide finished Work, tested and ready for operation and complete in every regard. Provide Work not shown or specified and accessories necessary to make the Work shown on the Drawings complete and ready for operation. Should there appear to be discrepancies or questions of intent in the Contract Documents, refer the matter to the UNLV P.M. for his decision. The decision of the UNLV P.M. is final.
- C. Drawings are diagrammatic and are intended to convey scope of Work and to indicate general arrangement. They are not intended to show every detail including offset or fitting or every structural difficulty that may be encountered during the Work. Except as otherwise indicated, locations of items are approximate only. Exact locations necessary to secure proper conditions and results must be determined at Project Site and must be approved by the Owner. Do not scale Drawings.
- D. Except as otherwise indicated, make only approved modifications in layout as needed to prevent conflict with other Work or for proper execution of Work.
- F. Include Work not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in Work.

3.06 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 2,160 ft above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficiency, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor

insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.06 COUPLINGS

- A. Couplings for direct drive equipment shall be flexible, self-aligning, non-lubricating type, rated at least 125% of motor rated horsepower.
- B. Coupling halves shall be keyed and locked on shafts.
- C. Manufacturer: Couplings shall be Fast's Standard, or John E. Lisee Pump, Inc.

2.07 BELT DRIVES

- A. General
 - 1. Belt drives shall be V-belt type with appropriate sheaves.
 - 2. Minimum of two belts per drive.
 - 3. Motors 15 HP and smaller shall be provided with variable pitch sheaves and installed on motor slide rails.
 - 4. Motors 20 HP and larger shall have non-adjustable drive sheave and be installed on motor slide rails.
 - 5. After air balance is completed and air balance has been accepted by the Engineer/ UNLV P.M., change each variable pitch sheave to fixed pitch sheave.
 - 6. Manufacturer: Sheaves and belts shall be Browning, Dodge, or Gates.
- B. Sheaves
 - 1. Sheaves shall be cast iron, machined and balanced.
 - 2. Variable pitch sheaves shall be selected for mid-point of equipment operating capacity.
 - 3. Sheaves shall be keyed and located on shafts, with Allen head set screws. On fractional horsepower motors on NEMA frame size 48, smaller sheaves may be secured to shaft with set screws only.
- C. Ratings
 - 1. Belt drives for one and two cylinder reciprocating compressors: Minimum horsepower rating, at design speed, of 1.7 times the motor nameplate horsepower rating.
 - 2. All other belt drives: On each two belts drive, each belt shall be rated for motor nameplate horsepower rating. On three belts or greater, drive shall be rated for 150% of motor nameplate horsepower rating.

2.08 GUARDS

- A. General: All rotating elements on equipment shall have protective devices in accordance with the CCR Title 8, Division of Industrial Safety and General Industry Safety Orders and OSHA requirements.
- B. Coupling guards shall completely enclose the rotating coupling and shall be constructed of heavy gage steel in accordance with OSHA requirements.
- C. Belt Guards
 - 1. Guards shall totally enclose the belts and sheaves. Guards shall be fabricated of galvanized expanded metal sides, solid galvanized steel band and adequately sized galvanized angle iron frame.
 - 2. Adequate room for belt adjustments shall be provided.
 - 3. Tachometer holes with covers shall be provided for both sheaves.
 - 4.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.03 PERFORMANCE REQUIREMENTS

- A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- B. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Equipment supports.
- C. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to **AWS D1.1, "Structural Welding Code--Steel."**
- B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.02 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
1. Thermo Hanger Shield, Inc.
 2. Portable Pipe,
 3. Hanger, Inc.
 4. Channel Support Systems
 5. Miro Industries
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
1. PHS Industries, Inc.
 2. Pipe Shields, Inc.
 3. Rilco Manufacturing Company, Inc.
 4. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.04 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.05 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 - 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
- H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- I. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.
- G. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- I. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining Insulation.
 - 3. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - 4. Insert Material: Length at least as long as protective shield.
 - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 **painting Sections**.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Housed spring mounts.
 - 5. Elastomeric hangers.
 - 6. Spring hangers.
 - 7. Spring hangers with vertical-limit stops.
 - 8. Seismic snubbers.
 - 9. Steel and inertia, vibration isolation equipment bases.

1.03 DEFINITIONS

- A. IBC: International Building Code, 2006

1.04 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment where indicated on the drawings.
- B. Provide minimum static deflection of isolators for equipment as indicated on the drawings.
- C. Seismic-Restraint Loading:
 - 1. As defined in the IBC.
 - 2. As specified by Structural documents for this project.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of Nevada responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
 - d. Pre-approval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.
- F. Manufacturer's field reports.
- G. Project Record Documents: Record actual locations of hangers including attachment points.

1.06 QUALITY CONTROL

- A. Comply with seismic-restraint requirements in the IBC.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage pre-approval by an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear

and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. I.S.A.T (International Seismic Application Technology).
 - 3. Kinetics Noise Control.
 - 4. Mason Industries.
 - 5. M.W. Sausse/Vibrex
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene or hermetically sealed compressed fiberglass.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.
- G. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hangerrods. Color-code or otherwise identify to indicate capacity range.
- H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside 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. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- I. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside 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.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.02 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amber/Booth Company, Inc.
 2. Kinetics Noise Control.
 3. Mason Industries.
 4. M.W. Sausse
- B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
 1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails readyfor placement of cast-in-place concrete.
 1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.03 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amber/Booth Company, Inc.
 2. Hilti, Inc.
 3. Kinetics Noise Control.
 4. Mason Industries.
 5. TOLCO Incorporated; a brand of NIBCO INC.
 6. Unistrut; Tyco International, Ltd.80.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant

neoprene, with a flat washer face.

- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.04 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 7 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
3. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
4. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
5. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
6. Set anchors to manufacturer's recommended torque, using a torque wrench.

7. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.05 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 1 Section "Demonstration and Training."

3.07 OWNER'S FIELD VERIFICATION

- A. Provide services of testing agency to take noise measurement per Owner's request for two (2) eight (8) hour days (non-concurrent) as scheduled with Owner's designated representative. Use meters meeting requirements of ASA 47 (ANSI S1.4).

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Warning tags.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers:
 - 1. Brady Corporation,
 - 2. Brimar Industries, Inc
 - 3. Marking Services, Inc (MSI)
 - 4. Panduit Corporation,
 - 5. Seton Identification Products

2.02 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.03 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.04 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to [cover full] circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.05 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Yellow.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.06 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Aluminum.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.07 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO

- NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of **[50 feet]** along each run. Reduce intervals to **[25 feet]** in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Provide red ceiling tacks $\frac{3}{4}$ " Diameter to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- E. Room temperature sensors shall have engraved nameplates on wall adjacent to temperature sensor that identify the room number, zone number and the HVAC unit number that serves that room.

3.04 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of **50 feet** in each space where ducts are exposed or concealed by removable ceiling system.

3.05 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Drawings, all addendums, General and Special Conditions of the Contract, Divisions 00 and 01 Specification Sections, apply to this Section.
- B. Testing, Adjusting, and Balancing HVAC systems will be performed by a firm contracted separately by the Owner.
- C. This Section includes the TABA and Contractor requirements for the testing, adjusting, and balancing of HVAC systems to produce design objectives, including the following:
 - 1. Balancing airflow within distribution systems, including sub mains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Setting quantitative performance of HVAC equipment.
 - 4. Measuring Equipment vibration.
 - 5. Reporting results of the activities and procedures specified in this Section.
 - 6. Balancing of domestic hot and tempered water return systems.

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Document AIA A201 – General Conditions: Inspections, tests, and approvals required by public authorities.
- B. Document AIA A201 – General Conditions
- C. Section 01 40 00 – Quality Control
- D. Section 01 43 26 – Testing Laboratory/Agency Services
- E. Section 01 75 00 – Starting of Systems
- F. Section 01 75 10 – System Demonstration
- G. Section 01 31 30 – Testing, Adjusting, and Balancing
- H. Individual Sections: Qualification of testing organization; specific services required. Where there is any conflict of services or directions between Sections regarding the Testing and Balancing of Systems, contact the Architect immediately.

1.03 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including sub mains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high Air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. System Effect: A phenomenon that can create undesired
- E. or unpredicted conditions that cause reduced capacities in all or part of a system.

- F. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- G. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- H. Test: A procedure to determine quantitative performance of a system or equipment.
- I. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- J. AABC: Associated Air Balance Council.
- K. AMCA: Air Movement and Control Association.
- L. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.04 SUBMITTALS

- A. Draft Reports: prior to commencing work, submit a detailed agenda of balancing procedures for this project. Include a draft report utilizing proper and relevant report forms appropriate to the procedures. The forms shall be essentially completed with design criteria and approved performance data of the equipment approved for use. This shall be representative of the information to be included in the final report. Accompanying this agenda/draft report shall be a complete set of approved performance submittal data on equipment relevant to the HVAC systems, etc. Also, submit the AABC National Project Performance Guarantee, or the acceptable equivalent thereof.
- B. Test Reports: Prior to the final acceptance of the project, submit for approval and for inclusion into the operating and maintenance manuals. Provide the report in six copies, letter size, spiral-type (3-ring for larger reports) permanent binder, with index page, tabs, with cover identification. The report shall also include a significant General Comments section identifying unusual or incomplete final conditions that could not be remedied fully or satisfactorily. This shall also summarize such significant data that may appear on individual test data sheets. Included in the report shall be reduced scale drawings with air outlets and equipment identified to correspond to the data sheets but also the final as-built, contract drawings with respect to mark numbers, room numbers and other significant physical I.D., etc. Also show final locations of thermostats, sensing elements and duct traverses. The report shall provide evidence that all reasonable efforts on the part of the TABA and the related trades shall have been performed sufficiently to remedy any remaining deficiencies.

The report shall include an appendix with copies of all Site Inspection Reports (or equivalent thereof) issued by the TABA and the responses by any and all parties, relevant to the Inspection Reports. In addition, shall there have been RFI's & Change Orders affecting the TAB work, they shall be included.

- C. Copies of the approved performance curves, charts, etc., on all fans, pumps, chillers, towers, boilers, etc. shall be included in a separate section or appendix of the TAB report.

It is the responsibility of the Architect and Consulting Engineer to provide "approved" copies of the appropriate submittal/performance data of the equipment involved in the installation. They shall also provide copies of the appropriate drawings and specifications, addenda, change borders, etc., required by the TABA to perform their work.

- D. Report Forms: Forms utilized shall be significantly similar to the forms of the AABC National Standards.

1.05 QUALIFICATION AND QUALITY CONTROL

- A. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and the AABC Procedures Manual; these shall be considered the minimum criteria. Agencies shall be certified by AABC and all work shall be performed under the direct field supervision of an AABC certified TBE.
- B. The successful TABA shall be immediately provided with the necessary contract drawings, approved submittal data, etc., required to enable their critique of the contract drawings, addenda and specifications with respect to determining the "balance-ability" of the systems. This report shall be given to the Owner, Architect and Engineer. The TABA shall expedite this important aspect of TAB services.

1.06 GENERAL SCOPE OF WORK

- A. Testing, Adjusting and Balancing of the heating, ventilating and air conditioning (HVAC) systems.
- B. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and shall be considered the minimum criteria. These Standards are to be used and applied on the appropriate scope of the systems utilized and installed in and on this project. The TABA shall be totally familiar with these Standards and further detailed directions will not be provided unless specifically stated herein.
- C. Test & Balance Agencies (TABA) shall be certified by the AABC, and all work shall be performed under the direct field supervision of an AABC certified TBE. All TABA firms shall have a permanent office in So. Nevada, locally manned with certified personnel and a Test & Balance Engineer. The TABA shall have been a member agency in good standing with their association for a minimum of three (3) years.

1.07 PROJECT CONDITIONS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.
- B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.08 COORDINATION

- A. Contractor and the Contractor's representatives shall coordinate the systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- C. Commissioning Agency will coordinate with TABA.

1.09 RESPONSIBILITY OF CONTRACTOR

- A. Should the TABA be unable to perform his work or be required to redo his work because HVAC System(s) (elements, components or subsystems) are not ready or are improperly installed, any additional costs, herein related and approved by the owner, shall be back charged to the Contractor.
- B. Contractor and all Sub-Contractors shall cooperate fully with the TABA to efficiently complete the systems and their balancing.
- C. Other than their instrumentation, gauges, etc., the TABA shall not provide nor install any devices or components. It is the responsibility of the Contractor to ensure the necessary assistance and coordination is provided which shall include (but not limited to):
 - 1. Calibration of all controls (includes providing of instrumentation and software necessary to the operation of same, i.e. computers, etc.), providing and installing of drives, dampers, filters, access, test holes, gauges and taps (properly located), sealing of holes and insulation, removal and replacement of ceiling and/or tiles, water systems cleaned and flushed, duct leakage and pressure testing, proper motor starters and heaters installed, volume, fire and smoke/fire dampers, diffusers, grilles. All duct-mounted dampers shall be placed and locked in a full open position and clearly "flagged" for ease of location. The ceiling tile shall be clearly and permanently ID'd, for everyone's knowledge of access. Hard ceilings shall be provided with permanent access. Where required the contractor(s) shall provide the necessary and adequate lifts and scaffolds.
 - 2. All systems shall be checked, tested and started prior to turning them over to the TABA, and the report of same, in writing, provided to the TABA, as well as the owner. Contractor shall have a competent technician or tradesmen available during the testing and balancing of the systems. There shall be an HVAC technician, fully familiar with the systems, on site full time during the work of the TABA.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine equipment for installation and for properly operating safety interlocks and controls.
- F. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- G. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multi-zone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 9. Interlocked systems are operating.

10. Changeover from heating to cooling mode occurs according to design values.

1.10 WARRANTY

- A. General Warranty.
- B. Provide one-year full warranty from date of, Substantial Completion.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in Division 1 Section "Project Record Documents."
- D. Examine system and equipment test reports.
- E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing, and
Report all deficiencies to UNLV Project Manager.
- G. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- H. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- I. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures to UNLV Project Manager.

3.02 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures:

1. Before commencing work, as best as can be done, verify that systems are complete, operable and ready to balance. The TABA shall not begin their work until they (and the Owner) have received, in writing, from the installing contractors and the commissioning agency, that all of the systems have been completed, checked, tested and started and are completely ready for the TABA to begin their work.
- B. This project will be accomplished in phases and the TABA shall visit the site and review the Work during systems installations for each phase. A written report (Site Inspection Report) of these inspections shall be sent to the Owner, Engineer and Contractor.
- C. The TABA shall provide daily Site Inspection Reports during performance of the work. Reports shall list any defects, deficiencies or abnormal conditions observed in the systems, which may prevent systems balance, or compromise the proper operation of the systems. Reports shall be sent via fax or Email, by the following workday, to the Owner, Engineer and Contractor. Additionally, the prime Contractor shall provide a three-ring binder, on site, wherein copies of these reports/inspections shall be placed for the use of the contractors, inspectors or others.

Each of the above-notified parties shall document acceptance and receipt of these Reports by signing same, and returning that document to the owner or his representative and the TABA.
- D. Recorded data shall represent actually measured or observed conditions and appropriate ambient conditions.
- E. The intent and goal of testing and balancing is to have a completed system(s) functioning per design and has no deficiencies. The fullest cooperation between the TABA, Commissioning Agency and the Contractor and his trades is essential.

3.03 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.
- B. The TABA shall permanently mark settings of valves, dampers and other adjustment devices. Set and lock memory stops and mark them. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.04 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder (6copies), tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing Engineer.
- C. Include a list of the instruments used for procedures, along with proof of calibration.
- D. Final Report Contents: In addition to the certified field report data, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
 6. All sight inspection and deficiency reports done by TABA.
 7. Domestic hot and tempered water return systems final reading.

- E. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of testing, adjusting, and balancing Agent.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name, address, and approval stamp.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of testing, adjusting, and balancing Agent who certifies the report.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Polyisocyanurate.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Lagging adhesives.
- 6. Sealants.
- 7. Factory-applied jackets.
- 8. Field-applied jackets.
- 9. Tapes.
- 10. Securements.
- 11. Corner angles.

- B. Related Sections:

- 1. Division 22 Section "Plumbing Insulation."
- 2. Division 23 Section "Metal Ducts" for duct liners.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 3. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 4. Detail application of field-applied jackets.
 - 5. Detail application at linkages of control devices.
 - 6. Detail field application for each equipment type.
- C. Qualification Data: For qualified Installer.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include

dates of tests and test methods employed.

- E. Field quality-control reports.
- F. Acoustical duct liner.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Insulation thickness and R-value shall comply with ASHRAE/ANSI Standard 90.1-2004.

- B. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Thickness for foam having K-factor of 0.165 may be required from that indicated for mineral fiber insulation having K-factor of 0.24 provided the equivalent thermal resistance is maintained.
- H. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Certain Teed Corp.
 - b. Owen Corning
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- I. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- J. Mineral-Fiber Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket. For equipment applications, provide insulation without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
- K. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Owens Corning; Fiberglas Pipe and Tank Insulation.
- M. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Trymer.
 - b. HiTherm
 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.165 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
 3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
 4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Pipe Applications: ASJ-SSL.
 - b. Equipment Applications: ASJ-SSL.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. Products: Subject to compliance with requirements, provide one of the following
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
1. Products: Subject to compliance with requirements, provide one of the following
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F .
 - 1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products
 - b. Ductmate Industries
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Ductmate Industries
 - d. Design Polymenics
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Ductmate Industries
 - d. Design Polymenics
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Design Polymenics
 - d. Ductmate Industries
 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
 3. Service Temperature Range: Minus 50 to plus 180 deg F.
 4. Color: White.

2.06 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Ductmate Industries
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 100 to plus 300 deg F.
 5. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.

2.07 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.08 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 0.03-inch thick; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. Factory-fabricated tank heads and tank side panels.

2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mil.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 0.015 inch thick, 3/4 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch) thick, 3/4 inch wide with wing or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.135-inch-** diameter shank, length to suit depth of insulation

indicated.

- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch) galvanized carbon- steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.11 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch aluminum according to ASTM B 209 Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.04 PENETRATIONS

- A. Insulation installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation installation at Underground Exterior Wall Penetrations: Terminate insulation flush with

sleeve seal. Seal terminations with flashing sealant.

- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 Section "Thermal and Moisture Protection" firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Thermal and Moisture Protection".

3.05 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same

- material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple

longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.07 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. **Seal longitudinal seams and end joints with manufacturer's** recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- C. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- D. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rate per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.09 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of polyisocyanurate insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped

- butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.11 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

TABLE 23 07 00-A
PIPE INSULATION SCHEDULE
INSULATION THICKNESS FOR NOMINAL PIPE SIZES

<u>SYSTEM</u>	<u>TEMP.</u> <u>RANGE</u>	1 AND LESS <u>IN.</u>	1-1/4 TO 2 <u>IN.</u>	2-1/2 TO 4 <u>IN.</u>	6 AND UP <u>IN.</u>	<u>JACKET</u>
Condensate Drain	Any	0.5	0.5	0.5	--	All Service

NOTE: All insulation exposed to weather shall be provided with aluminum covering.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 - 1. None.
- D. Piping, Exposed (Including Mechanical Rooms):
 - 1. PVC: 0.03 inches thick.
 - 2. Aluminum, Smooth: 0.016 inch .

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

TABLE 23 07 00-C
DUCT INSULATION SCHEDULE

<u>SYSTEM</u>	<u>LOCATION</u>	<u>INSULATION</u>	<u>JACKET</u>
Supply Air Heating & Cooling	Concealed/ Exterior	Glass Fiber 2 Inch	All Service Flexible
Supply Air Heating & Cooling	Exposed in Cooled & Heated Space	Glass Fiber 1-1/2 Inch	Flexible Coating Per 2.1
Return Air Flexible	Concealed In Uncooled Or Unheated Space	Glass Fiber 1-1/2 Inch	All Service
Return Air	Concealed Or Exposed In Cooled And Heated Space	None	None
Return Air	Exposed In Uncooled Or Unheated Space	Glass Fiber Flexible	Per 2.1
Coating As Insulation,	Or Mechanical Rooms	1-1/2 Inch	
Outside Air	All	Glass Fiber 2 Inch	Flexible Coating Per 2.1

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

TABLE 23 07 00-D
EQUIPMENT INSULATION SCHEDULE

<u>Cooled Equipment</u>	<u>Insulation</u>	<u>Finish Cover</u>
Air Conditioning Equipment Housings, Interior Insulation, 1 Inch	Glass Fiber-Coated Semi-Rigid Board	Glass Cloth With Vapor Barrier

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

END OF SECTION

SECTION 23 21 14

CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Condensate-drain piping.

1.03 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Condensate-Drain Piping: 150 deg F.

PART 2 – PRODUCTS (All piping and accessories shall be manufactured in the U.S.A.)

2.01 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. Wrought-Copper Fittings: ASME B16.22.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.
- D. Wrought-Copper Unions: ASME B16.22.

2.02 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

2.03 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Capitol Manufacturing Company.
 - a. Central Plastics Company.
 - b. Hart Industries International, Inc.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - d. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F

D. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

E. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Victaulic Company of America.

PART 3 – EXECUTION

3.01 PIPING APPLICATIONS

- A. Condensate-Drain Piping: Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

3.02 PIPING INSTALLATIONS

- A. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- D. Install piping at indicated slopes.
- E. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections.
- G. Install piping to allow application of insulation.
- H. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap and chain, at low points in piping system mains and elsewhere as required for system drainage.

- I. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- J. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- K. Mechanically formed (pulled) tee fittings in main pipe, are not acceptable.
- L. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- M. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.03 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS ¾: Maximum span, 5 feet; minimum rod size, 1/4 inch
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch
 - 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch
 - 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch
 - 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch
 - 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.04 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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 unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING AND SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Filter-dryers.
- E. Flexible connections.

1.02 RELATED SECTIONS

- A. Section 09 90 00 – Painting.
- B. Division 23 – HVAC Insulation.
- C. Division 28 – Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.03 REFERENCES

- A. ARI 495 – Refrigerant Liquid Receivers.
- B. ARI 710 – Liquid Line Dryers.
- C. ARI 730 – Flow-Capacity Rating and Application of Suction-Line Filters-Dryers.
- D. ARI 750 – Thermostatic Refrigerant Expansion Valves.
- E. ARI 760 – Solenoid Valves for Use with Volatile Refrigerants.
- F. ASHRAE 15 – Safety Code for Mechanical Refrigeration.
- G. ASHRAE 34 – Number Designation of Refrigerants.
- H. ASME – Boiler and Pressure Vessel Codes, SEC 9 – Qualification Standard for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators.
- I. ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- J. ASME B16.26 – Cast copper Alloy Fittings for Flared Copper Tubes.
- K. ASME B31.5 – Refrigeration Piping.
- L. ASME B31.9 – Building Services Piping.
- M. ASME SEC 8D – Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.
- N. ASTM A53 – Pipe, Steel, Black and Hot-Dipped, zinc-Coated, Welded and Seamless.
- O. ASTM A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

- P. ASTM B88 – Seamless Copper Water Tube.
- Q. ASTM B280 – Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- R. ASTM F708 – Design and Installation of Rigid Pipe Hangers.
- S. AWS A5.8 – Brazing Filler Metal.
- T. AWS D1.1 – Structural Welding Code, Steel.
- U. MSS SP58 – Pipe Hangers and Supports – Materials, Design and Manufacturer.
- V. MSS SP69 – Pipe Hangers and Supports – Selection and Application.
- W. MSS SP89 – Pipe Hangers and Supports – Fabrication and Installation Practices.
- X. UL 429 – Electrically Operated Valves.

1.04 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardize. Provide necessary joining fittings. Ensure flanges, union and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with MSS SP69 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
 - 3. Use line size on leaving side of liquid solenoid valves.
- D. Permanent Filter-Dryers:
 - 1. Use in low temperature systems.
 - 2. Use in systems utilizing hermetic compressors.
 - 3. Use filter-dryers for each solenoid valve.
- E. Flexible Connectors: Utilize at or near compressors or other vibrating/rotating equipment where piping configuration does not absorb vibration.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions and sizes.
- B. Product Data: Provide general assembly of specialties, including manufacturer's catalogue information. Provide manufacturers catalog data including load capacity.
- C. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Test Reports: Indicate results of leak test, acid test.
- E. Manufacturer's Installations: Indicate support, connection requirements and isolation for servicing.
- F. Submit welder's certification of compliance with ASME SEC 9.

1.06 PROJECT RECORD DOCUMENTS

- A. Record exact locations of equipment and refrigeration accessories on record drawings.

1.07 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include instructions for changing cartridges, assembly views, and spare parts lists.

1.08 QUALIFICATIONS

- A. Installer: Company specializing in performing the work of this section with minimum 3 years experience.

1.09 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable State labor regulations.
- C. Welder's Certification: In accordance with ASME SEC 9.
- D. Products Requiring Electrical Connection: Listed and classified by UL, as Suitable for the purpose indicated.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

1.11 MAINTENANCE MATERIALS

- A. Provide two filter-dryer cartridges of each type.

PART 2 – PRODUCTS

2.01 PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCup silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- B. Pipe Supports and Anchors:
 - 1. Conform to MSS SP69.
 - 2. Hangers for Pipe Sizes ½ to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
 - 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hangers rods.
 - 4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 5. Vertical Support: Steel riser clamp, unistrut wall anchor.
 - 6. Floor Support: Steel clamp, unistrut, expansion anchor.
 - 7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 8. Hanger Rods: Mild steel threaded both ends, threaded one end or continuous threaded.
 - 9. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.02 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum working pressure of 500 psig, and maximum temperature of 200 degrees F.

2.03 FLEXIBLE CONNECTORS

- A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 400 psig.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return
- E. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.

F. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

G. Pipe Hangers and Supports:

1. Install in accordance with MSS SP89.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum $\frac{1}{2}$ inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Support vertical piping at every floor. Support riser piping independently or connected HORIZONTAL PIPING.

6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double as risers required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings.
- K. Flood piping system with nitrogen when brazing.
- L. Where pipe support members are welded to structural building frame, brush clean and apply one coat of zinc rich primer to welding.
- M. Prepare unfinished pipe, fittings, supports and accessories ready for finish painting. Refer to Section 09 90 00.
- N. Insulate piping; refer to Division 23.
- O. Provide access to concealed valves and fittings.
- P. Flood piping system with nitrogen when brazing.
- Q. Where pipe support members are welded to structural building frame, brush clean and apply one coat of zinc rich primer to welding.
- R. Provide access to concealed valves and fittings.
- S. Flood piping system with nitrogen when brazing.
- T. Where pipe support members are welded to structural building frame, brush clean and apply one coat of zinc rich primer to welding.
- U. Prepare unfinished pipe, fittings, supports and accessories ready for finish painting. Refer to Section 09 90 00.
- V. Insulate piping; refer to Division 23.
- W. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- X. Provide replaceable cartridge filter-dryers, with isolation valves and valved bypass.
- Y. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- Z. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- AA. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- BB. Fully charge completed system with refrigerant after testing.
- CC. Provide electrical connection to solenoid valves. Refer to Division 26.

3.03 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.
8. Medium Pressure Ductwork

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. SMACNA + 2.0" w.g. static pressure class and 2500 FPM maximum velocity.
 - a. Relief air ductwork.
 - b. Outside air ductwork.
 - c. Supply air ductwork from VAV terminals to air devices.
2. SMACNA - 2.0" w.g. static pressure class and 2500 FPM maximum velocity.
 - a. Return air ductwork.
 - b. Outside air ductwork.

- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE 7.

1.04 SUBMITTALS

- A. Product Data: For each type of the following products:

1. Liners and adhesives.

2. Sealants and gaskets.
3. Seismic-restraint devices.
4. Duct Construction Standards

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports and seismic restraints.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed change to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

E. Welding certificates.

F. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to "Structural Welding Code - Steel," for hangers and supports and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams – Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct- support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
Single Wall Round Duct:
 - a. ASI
 - b. SEMCO
 - c. United McGillGrooved Mechanical Joint Fittings and Couplings:
 - a. Anvil Grivlok
 - b. Grinnell
 - c. Shurjoint Piping Products, Inc.
 - d. Victaulic Company
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for

static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SHEET METAL MATERIALS

- A. General Material Requirements: 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. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. 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.

2.04 MEDIUM PRESSURE DUCTS

- A. Fabricate and support in accordance with SMACNA Medium Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.
- C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
- D. Fabricate continuously welded medium pressure round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

2.05 SEAMS AND JOINTS

- A. Longitudinal seams shall be Pittsburgh, or equal (no known equal) lock with 3/8 inch minimum pocket.
- B. Round Ductwork: Transverse joints in low pressure round ducts to be beaded sleeve joint secured with sheet metal screws equally spaced on 6 inch centers maximum with a minimum of 3 screws per joint. Round duct elbows shall be stamped or segmented; adjustable elbows are not acceptable. Seal joints with sealant.
- C. Rectangular Ductwork: Construct all seams and joints in rectangular ductwork in accordance with SMACNA "HVAC Duct Construction Standards,". Seal all transverse joints with duct sealant.
- D. Seal each duct transverse joint and longitudinal seam with a duct sealant. Use hardcast DT tape with RTA adhesives or equal (no known equal), for exterior ductwork.

2.06 FITTINGS FOR MEDIUM PRESURE DUCTS

- A. Elbows: All elbows shall have an inside radius not less than the width of the ducts in the direction of the curve. Where space conditions do not permit a full radius elbow, changes in direction shall be made using mitered elbows with multiple double thickness turning vanes.
 - 1. Construct radius elbows in accordance with the "HVAC Duct Construction Standards,". Short radius elbows are not allowed.
 - 2. Construct vaned elbows of double vanes in accordance with the "HVAC Duct Construction Standards,". Single vane elbow shall not be used.
- B. Construct transitions and offsets in accordance with the "HVAC Duct Construction Standards,".
 - 1. Transitions: Maintain full duct cross section areas through transitions. Angle between centerline and side of diverging transition shall be no greater than 15 degrees in lieu of 20 degrees shown in the "Low Pressure Duct Manual." Angle between centerline and side of converging transition shall be no greater than 30 degrees.
 - 2. Offsets: Construct with inside radii not less than the width of the duct in the direction of the curbs. Mitered elbows as specified under Subparagraph, "Elbows," herein may be used where space is restricted.
- C. Collar taps for air outlet connections on exposed ductwork to be made with joint connection folded over inside of main duct and without exposed flanges. Outlet collar to be of same dimension as outside dimension of air outlet frame.
- D. Make branch connections in accordance with SMACNA and as otherwise indicated on the Drawings.
- E. Outlet Frames: Where ducts terminate at grilles, registers or diffusers, furnish with angle or channel iron frames with mitered welded corners and with provisions for attaching said grilles, registers, or diffusers.
- F. Access Doors: Hinged, airtight, access doors shall be provided where required for access to control elements or for inspection. Size doors for maintenance of concealed items. Construct access doors in accordance with "HVAC Duct Construction Standards,". Furnish hinged doors except where space does not allow the door to swing open furnish removable doors. Insulate access doors where ducts are insulated with same insulation as on ductwork or housing.
- G. Make connections between ductwork and outlets with flexible duct material herein specified. (Unless otherwise specified on drawings).

2.07 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 3. Thickness:
 - a. 1/2 inch-VAV box internal insulation/lining.
 - b. 1 inch-First 10 feet from VAV box discharge and first 15 feet from exhaust fan inlet, or as indicated on plans.
 - c. 2 inch-First 20 feet from air handling unit supply, return, outside air and relief air connections and first 20 feet from return/relief air fan inlet and outlet connections, or as indicated on plans
 4. Metal Liner: Ductwork provided with internal sound lining at connections to air handling units or fans shall have a perforated galvanized metal inner liner covering the sound liner.
 5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 6. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.08 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: **3 inches.**
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg. positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.

- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.09 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.10 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti Corp.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. TOLCO; a brand of NIBCO INC.
 - 7. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized steel cables with end connections made of

cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
- M. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring. (Unless otherwise specified on drawings).

- N. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- O. Adhere to Drawings: Run and shape of ducts offsets during progress of work may be varied, if required to meet structural or other interferences, as approved.
- P. Install ductwork in adherence to ceiling height shown on Drawings. Establish necessary space requirements so as to maintain required clearances around all equipment.
- Q. Reinforce all ducts to prevent buckling, breathing, vibrations or noise, such reinforcing shall be as recommended in the reference specified herein.

3.02 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet .
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.04 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE 7.
 - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports

- amaximum of 80 feet o.c.
 - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.05 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.07 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
 - 2. Test the following systems:
 - a. Supply air.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before insulation application.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
6. Make adjustments of the mechanical equipment in accordance with the Plans and Specifications as necessary, so the air balance testing agency which will be contracted by the Owner can complete its work. If it is found that any portion of the Work has not been installed as specified for accomplishing the testing and balancing as called for in the Specifications, the Work shall be redone at no additional cost.
7. Test Equipment: Use equipment arranged as recommended by the testing and balancing agency specified in Section 23 05 93.
8. Field Test Procedures
 - a. Seal all openings in duct section to be tested.
 - b. Connect test apparatus to test section of duct, using a flexible duct connection or hose.
 - c. Close damper or blower suction side to prevent excessive build up of pressure.
 - d. Start blower and gradually open damper on suction side of blower.
 - e. Build up pressure in duct test section to 4 inches WG.
 - f. Record indicated pressure on instrument that is connected to section of duct under test.
 - g. Maintain this pressure for ten minutes and check for audible leaks. Mark location of each leak.
 - h. Reduce pressure to 0 inch WG and repair all visual and audible leaks.
 - i. Upon completion of repairs, build up pressure to design operating pressure, and read leakage pressure on instrument connected across test apparatus orifice.
 - j. Leakage C.F.M. to be read by consulting chart calibrated with orifice diameter. If no leakage exists, zero pressure differential shall be indicated. Leakage C.F.M. shall not exceed 3%. Repeat procedure as indicated above until leakage rate is met.
9. Engage the testing agency specified in Section 23 05 93, to verify the leakage tests of all ducts and submit a certification attesting to the results obtained.
10. Tested sections of ductwork to be visually marked by agency with certification sticker and initials of field test inspector. Tests shall be made before duct sections are concealed.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.
- F. Adjustment and cleaning.
 - 1. Balancing and Adjusting: Make adjustments of the mechanical equipment in accordance with the Plans and Specifications as necessary, so the air balance testing can complete its work. If it is found that any portion of the Work has not been installed as specified for accomplishing the testing and balancing as called for in the Specifications, the Work shall be redone at no additional cost.

3.08 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- C. Liner:
 - 1. 1/2 inch-VAV box internal insulation/lining.
 - 2. 1 inch-First 10 feet from VAV box discharge and first 15 feet from exhaust fan inlet, or as indicated on plans.
 - 3. 2 inch-First 20 feet from rooftop air handling unit supply, return, outside air and relief air connections and first 20 feet from return/relief air fan inlet and outlet connections, or as indicated on plans
- D. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 with turning vanes.
 - b. Velocity 1000 to 1500 fpm :
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio..
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

- 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
- 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
- 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - a. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - b. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: 45 degree entry with transition to round.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees."
 - a. Velocity 1000 fpm or Lower: 45 degree lateral
 - b. Velocity 1000 to 1500 fpm: 45 degree lateral.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

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. Duct accessory hardware.

B. Related Sections:

1. Division 28 Section for duct-mounted fire and smoke detectors.

1.03 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. Duct security bars.
 - f. 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. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.04 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.

1.05 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.01 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.
- 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

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.

- 3. Ruskin Company.
- 4. Potorff
- 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 and mounting flange.
- 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: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Galvanized steel.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- 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. Electric actuators.
 - 4. Chain pulls.
 - 5. Front of rear screens.
 - 6. 90-degree stops.
- N. Sleeve: Minimum 20-gage thickness.

2.03 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company.
 - 4. SEMCO Incorporated.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.064-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

- F. Blades:
 - 1. Multiple, 0.025-inch- thick, roll-formed aluminum.
 - 2. Maximum Width: 6 inches.
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Eccentrically pivoted.
- G. Blade Seals: Vinyl or Neoprene.
- H. Blade Axles: Galvanized steel.
- I. Tie Bars and Brackets:
 - 1. Material: Aluminum.
 - 2. Rattle free with 90-degree stop.
- J. Return Spring: Adjustable tension.
- K. Bearings: Bronze.
- L. Accessories:
 - 1. Flange on intake.
 - 2. Adjustment device to permit setting for varying differential static pressures.

2.04 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flexmaster U.S.A., Inc.
 - b. McGill AirFlow LLC.
 - c. METALAIRE, Inc.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
 - 2. Standard leakage rating.
 - 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. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements:
 - a. Flexmaster U.S.A., Inc.
 - b. McGill AirFlow LLC.
 - c. METALAIRE, Inc.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with 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. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
6. Blade Axles: Stainless 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: Aluminum.

2.05 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance
 2. Nailor
 3. Pottorff
 4. Ruskin
- B. Low-leakage rating 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. 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; galvanized 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.
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.

2.06 FIRE DAMPERS

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

1. Arrow United Industries.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

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 4000-fpm velocity.

D. Fire Rating: 1-1/2 to 3 hours.

E. Frame: Curtain type with blades outside 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.

2.07 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.

B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

- E. Frame: Curtain type with blades outside airstream fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- G. Smoke Detector: Integral, factory wired for single-point connection.
- H. Frame: Curtain type with blades inside airstream fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- I. 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.
- J. Leakage: Class II.
- K. Rated pressure and velocity to exceed design airflow conditions.
- L. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- M. Master control panel for use in dynamic smoke-management systems.
- N. Damper Motors: two-position action.
- O. 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
 - 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.
- P. Accessories:
 - 1. Auxiliary switches for position indication.
 - 2. Test and reset switches, damper mounted.

2.08 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ
 - 3. Ward Ind.

- B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and

components.

- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.09 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements:
- B. General Requirements:
 - 1. Factory fabricated.
 - 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
- C. Shape:
 - 1. Rectangular straight with splitters or baffles.
 - 2. Round straight with center bodies or pods.
 - 3. Rectangular elbow with splitters or baffles.
 - 4. Round elbow with center bodies or pods.
 - 5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.034 inch thick.
- E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.
 - 1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
 - 2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
 - 3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inch thick.
 - 4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.
- F. Inner Casing and Baffles: ASTM A 653/A 653M, G60 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch- diameter perforations.
- G. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- H. Principal Sound-Absorbing Mechanism:
 - 1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 - 2. Film-lined type with fill material.
 - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
 - 3. Lining: Mylar.
- I. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 - 1. Flange connections.
 - 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 - 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- J. Capacities and Characteristics: Refer to the drawings.

2.10 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. 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, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 24 inches wide and double wall for larger dimensions.

2.11 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pottorff; a division of PCI Industries, Inc.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed, 3/4 inches deep.
- F. Wall-Box Cover-Plate Material: Steel.

2.12 DUCT-MOUNTED ACCESS DOORS

- 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. 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.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.13 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. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. 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.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. 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.

2.14 DUCT ACCESSORY HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ
 - 4. Ward Industries
- B. 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.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 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 backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. 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 that channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Coordinate subparagraphs below with Division 23 Section "Metal Ducts." Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Connect ducts to duct silencers rigidly.
- I. 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. Adjacent to and close enough to fire or smoke dampers.
 - 3. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.

- K. 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.
- L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- P. Connect diffusers to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- Q. Install duct test holes where required for testing and balancing purposes.
1. Cut or drill temporary test holes in ducts as required. Cap with threaded metal caps.
 2. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
- R. 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.

3.02 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

SECTION 23 33 10

AIR DUCT CLEANING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 23 05 00 Common Work Results for HVAC
 - 2. Section 23 07 00 HVAC Insulation.
 - 3. Section 23 31 13 Metal Ducts.
 - 4. Section 23 33 00 Air Duct Accessories.

1.02 SUMMARY

- A. This Section includes cleaning of the following existing duct systems:
 - 1. Supply system.
 - 2. Return system.
 - 3. Exhaust system.

1.03 DEFINITIONS

- A. ASCS: Air system cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.
- C. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
- D. MSDS: Material Safety Data Sheets.
- E. OSHA: Occupational Safety and Health Administration.
- F. EPA: Environmental Protection Agency

1.04 SUBMITTALS

- A. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.
- B. MSDS: Submittal of EPA approved cleaning and sanitizing products.
- C. Qualification Data: For ASCS.
- D. Access Doors
- E. Field quality-control test reports.

1.05 QUALITY CONTROL

- A. ASCS Qualifications: A certified member of NADCA
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA
 - 3. Experience: Submit records of experience in the field of HVAC systems cleaning.
 - 4. Equipment, Materials, and Labor: Have equipment, materials, and labor required to perform specified services.

- B. Comply with current published standards of NADCA.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. See Section 23 33 00 "Air Duct Accessories" for approved manufacturers listings.

2.02 SHEET METAL 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.
- B. Galvanized-Steel Sheet: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.03 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class. **No sheet metal patches shall be allowed.**
- B. Rectangular Duct Door: Refer to Section 23 33 00 "Air Duct Accessories" for manufacturers of duct mounted access doors.

2.04 FLEXIBLE CONNECTORS

- A. General Description: Fabricate flexible connectors of manufactured products suitable for the duct pressure class.
- B. Products shall be as listed in Section 23 33 00 "Air Duct Accessories."

2.05 DUCT ACCESSORY HARDWARE

- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine systems to determine appropriate methods, tools, and equipment required for performance of work.
- B. Prepare written report listing conditions detrimental to performance of work.
- C. Proceed with work only after unsatisfactory conditions have been corrected.

3.02 CLEANING

- A. Engage a qualified ASCS to clean the following systems:
 - 1. Supply system.
 - 2. Return system.
 - 3. Exhaust system.
- B. Perform cleaning before air balancing or mark position of dampers and air-directional mechanical devices before cleaning.
- C. Use duct-mounted access doors, as required, for physical and mechanical entry and for inspection.
 - 1. Install additional duct-mounting access doors to comply with duct cleaning standards. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for additional duct-mounting access doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection. Replace damaged and deteriorated flexible ducts. Comply with requirements in Division 23 Section 23 33 00 "Air Duct Accessories" for flexible ducts.
 - 3. Disconnect and reconnect flexible connectors as needed for cleaning and inspection. Replace damaged and deteriorated flexible connectors. Comply with requirements in Division 23 Section 23 33 00 "Air Duct Accessories" for flexible connectors.
 - 4. Replace damaged fusible links on fire and smoke dampers. Replacement fusible links shall be same rating as those being replaced. Comply with requirements in Division 23 Section 23 33 00 "Air Duct Accessories" for fusible links.
 - 5. Remove and reinstall ceiling components to gain access for duct cleaning. Clean ceiling components after they have been removed and replaced.
- D. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.
- E. Particulate Collection and Odor Control:
 - 1. Where venting vacuuming system inside building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or greater) particles.
 - 2. When venting vacuuming system outside building, use filtration to contain debris removed from the HVAC system and locate exhaust down wind and away from air intakes and other points of entry into building.
- F. Clean the following metal-duct system components by removing visible surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers,

- and drive assemblies.
 - 3. Air-handling-unit internal surfaces and components including mixing box, coil section.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, and actuators, except in ceiling plenums and mechanical room.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components.
- G. Mechanical Cleaning Methodology:
- 1. Clean metal-duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of ducts so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts or duct liner.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment, and do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 6. Provide operative drainage system for washdown procedures.
 - 7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present; use according to manufacturer's written instructions after removal of surface deposits and debris.
- H. Cleanliness Verification:
- 1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
 - 2. Visually inspect metal-duct systems for contaminants.
 - 3. Where contaminants are discovered, reclean and reinspect duct systems.

3.03 DUCT ACCESSORIES 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, and Section 23 33 00 "Air Duct Accessories" of this specification.
- B. Provide 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 duct-mounting access doors where access doors do not currently exist to allow for the cleaning of ducts, accessories, and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers, turning vanes, and equipment.
 - 3. Adjacent to fire or smoke dampers; reset or install new fusible links.
 - 4. Before and after each change in direction, at maximum 50-foot spacing.
 - 5. On sides of ducts where adequate clearance is available.
- D. Install the following sizes for duct-mounting, rectangular access doors:

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.
- E. Install the following sizes for duct-mounting, round access doors:
1. One-Hand or Inspection Access: 8 inches in diameter.
 2. Two-Hand Access: 10 inches in diameter.
 3. Head and Hand Access: 12 inches in diameter.
 4. Head and Shoulders Access: 18 inches in diameter.
 5. Body Access: 24 inches in diameter.
- F. Install the following sizes for duct-mounting, pressure relief access doors:
1. One-Hand or Inspection Access: 7 inches in diameter.
 2. Two-Hand Access: 10 inches in diameter.
 3. Head and Hand Access: 13 inches in diameter.
 4. Head and Shoulders Access: 19 inches in diameter.

3.04 CONNECTIONS

- A. Reconnect ducts to fans and air-handling units with existing flexible connectors after cleaning ducts and flexible connectors. Replace existing damaged and deteriorated flexible connectors.
- B. For fans developing static pressures of 5-inch wg and higher, cover replacement flexible connectors with loaded vinyl sheet held in place with metal straps.

3.05 FIELD QUALITY CONTROL

- A. Gravimetric Analysis: Sections of metal-duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.
1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
 2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal-duct system shall be re-cleaned and re-verified.
- B. Verification of Coil Cleaning: Cleaning shall restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.
- C. Report results of tests in writing.

END OF SECTION

SECTION 23 34 16

CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Airfoil centrifugal fans.
 - 2. Backward-inclined centrifugal fans

1.03 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan performance ratings on 2160 ft. sea level.
- B. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- 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. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. 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.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Thermal and Moisture Protection".

1.08 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set(s) for each belt-driven unit.

1.09 MAINTENANCE AND EMERGENCY SERVICE

- A. Provide regular maintenance for the contract period from start up of the equipment through completion of the 12 month warranty period. Maintenance service for equipment shall be provided based on the manufacturer's recommendations, but at least every two months.
- B. Regular maintenance shall include a minimum of six filter replacement and a minimum of one drive belt replacement.
- C. Provide 24-hour emergency service for breakdowns and malfunctions. An emergency number shall be provided to the owner. A call back response shall be within four (4) hours of the phone call.
- D. Submit reports of maintenance and emergency services to include descriptions of malfunctions and repairs or replacements made.

PART 2 - PRODUCTS

2.01 AIRFOIL CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
 - 3. Trane
- B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- C. Housings: Formed panels to make curved-scroll housings with shaped cutoff, with doors or panels to allow access to internal parts and components.
 - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Horizontally split, bolted-flange housing.
 - 3. Spun inlet cone with flange.
 - 4. Outlet flange.
- D. Airfoil Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange; heavy backplate hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate and cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws and special coating.
- E. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
 - 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- F. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- G. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- H. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

- I. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor Size: 1.5.
 - 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 - 3. Motor Pulleys: Adjustable pitch for use with motors through [5] hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - 5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 - 6. Motor Mount: Adjustable for belt tensioning.
- J. Accessories:
 - 1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 - 2. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.
 - 3. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
 - 4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 - 5. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
 - 6. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
 - 7. Inlet Screens: Grid screen of same material as housing.
 - 8. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
 - 9. Spark-Resistant Construction: AMCA 99.
 - 10. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 - 11. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
- K. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Enclosure Type: Totally enclosed, fan cooled.
- L. Capacities And Characteristics: Refer to the Drawings

2.02 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
- B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- C. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Horizontally split, bolted-flange housing.
 3. Spun inlet cone with flange.
 4. Outlet flange.
- D. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- E. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- F. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- G. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- H. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- I. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor Size: 1.5.
 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 6. Motor Mount: Adjustable for belt tensioning.
- J. Accessories:
1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 2. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.
 3. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.

4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 5. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
 6. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
 7. Inlet Screens: Grid screen of same material as housing.
 8. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
 9. Spark-Resistant Construction: AMCA 99.
 10. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 11. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
 12. Hinged Curb Kit: With restraint cables.
- K. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Enclosure Type: Totally enclosed, fan cooled.
- L. Capacities And Characteristics: Refer to the Drawings

2.03 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Support floor-mounting units using restrained spring isolators having a static deflection of 1 inch (25 mm). Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

- F. Install units with clearances for service and maintenance.
- G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.
- D. Ground equipment according to Division 26.
- E. Connect wiring according to Division 26.

3.03 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
 - 10. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Perforated diffusers.
 - 3. Adjustable bar grilles.
 - 4. Fixed face grilles.
- B. Related Sections:
 - 1. Division 08 Section "Openings" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- E. Source quality-control reports.

PART 2 – PRODUCTS

2.01 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anemostat,
 - b. Carnes Co.
 - c. Krueger
 - d. Metal-Aire
 - e. Nailor Industries
 - f. Price Industries
 - g. Titus
 - h. Tuttle & Bailey
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.

B. Perforated Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - a. Anemostat,
 - b. Carnes Co.
 - c. Krueger
 - d. Metal-Aire
 - e. Nailor Industries
 - f. Price Industries
 - g. Titus
 - h. Tuttle & Bailey
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel backpan and pattern controllers, with steel face.
4. Finish: Baked enamel, white.

2.02 HIGH-CAPACITY DIFFUSERS

A. Drum Louver:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat,
 - b. Carnes Co.
 - c. Krueger
 - d. Metal-Aire
 - e. Nailor Industries
 - f. Price Industries
 - g. Titus
 - h. Tuttle & Bailey
2. Airflow Principle: Extended distance for high airflow rates.
3. Material: Aluminum, heavy gage extruded.
4. Finish: White baked acrylic.
5. Border: 1-1/4-inch width with countersunk screw holes.
6. Gasket between drum and border.
7. Body: Drum shaped; adjustable vertically.
8. Blades: Individually adjustable horizontally.
9. Mounting: Surface to duct.

2.03 REGISTERS AND GRILLS

A. Adjustable Bar Grill:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - a. Anemostat,
 - b. Carnes Co.
 - c. Krueger
 - d. Metal-Aire
 - e. Nailor Industries
 - f. Price Industries
 - g. Titus
 - h. Tuttle & Bailey
2. Material: Steel
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Vertical spaced 1/2 inch (13 mm) apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Horizontal spaced 1/2 inch (13 mm)] apart.
7. Frame: 1-1/4 inches (32 mm) wide.
8. Mounting: Countersunk screw.

B. Fixed Face Grill:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anemostat,
 - b. Carnes Co.
 - c. Krueger
 - d. Metal-Aire
 - e. Nailor Industries
 - f. Price Industries
 - g. Titus
 - h. Tuttle & Bailey
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Arrangement: Perforated core.
5. Core Construction: Integral.
6. Frame: 1-1/4 inches (32 mm) wide.
7. Mounting: Countersunk screw.

C. Linear Bar Grill:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anemostat,
 - b. Carnes Co.
 - c. Krueger
 - d. Metal-Aire
 - e. Nailor Industries
 - f. Price Industries
 - g. Titus
 - h. Tuttle & Bailey
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Arrangement: Perforated core.

2.04 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install diffusers and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 41 00

PARTICULATE AIR FILTRATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.03 DEFINITIONS

- A. DOP: Dioctyl phthalate or bis-(2-ethylhexyl) phthalate.
- B. HEPA: High-efficiency particulate air.
- C. ULPA: Ultra low penetration air.

1.04 SUBMITTALS

- A. Product Data: Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.
 - 1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
 - 2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air filters and are based on the specific system indicated.
- 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 ARI 850.
- D. Comply with ASHRAE 52.1 and ASHRAE 52.2 for method of testing and rating air-filter units.
- E. Comply with NFPA 70 for installing electrical components.

- F. Comply with NFPA 90A and NFPA 90B.

1.06 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide one complete set of filters for each filter bank. If system includes prefilters, provide only prefilters.
 - 2. Provide one container of red oil for inclined manometer filter gage.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Filters, and Filter-Holding Systems:
 - a. Ecco Air
 - b. Farr Co.
 - c. Cambridge
 - 2. Filter Gages:
 - a. Cambridge Filter Corp..
 - b. Dwyer Instruments, Inc.

2.02 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS

- A. Description: Factory-fabricated, dry, extended-surface filters with holding frames.
- B. Media: Fibrous material formed into deep-V-shaped pleats with anti-microbial agent and held by self-supporting wire grid.
- C. Media and Media-Grid Frame: Fire-retardant, 3/4-inch particleboard with gaskets.
- D. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

2.03 COMMODITY AND ASHRAE TYPE FILTERS - GENERAL

- A. Commodity type filters are specified as "commodity-type" or "ASHRAE-type" because it is intended that these filters fit within the range of filters generally covered by ASHRAE standards or manufactured by most filter manufacturers. These filters are distinguished from "specialty-type" filters because specialty filters may have some specific feature or absorption capability which is required by the Owner and is only manufactured by a single manufacturer.
- B. Cartridge type filters may be substituted for bag type filters for each high efficiency filter application during the construction phasing, when air handling unit is used during the construction work. The substitution of cartridge type filters will not however relieve the Contractor from providing the Owner with new bag type high efficiency filters after completion of all construction phase work, including clean-up phase.

- C. Manufacturer's names and catalog numbers given hereafter are intended to establish type, size, performance and standard of quality.
- D. Provide filter media for all air handling units, and replacement roof top air handling units, and at other locations as shown and scheduled on the drawings.
- E. Provide throw-away type filter media for all packaged terminal equipment such as fan coil units, cabinet unit heaters, and fan powered terminal boxes. Refer to the drawing schedules. Filter media shall be the size required by the terminal equipment device.

2.04 ASHRAE 30 PERCENT EFFICIENCY FILTERS (MERV 11)

- A. Provide 30 Percent Efficiency (MERV 11) Air Filters of the size and depth as scheduled on the drawings and as specified in other sections of this specification. Air filters shall be the pleated, disposable type. Each filter shall consist of synthetic fabric media, media support grid, and enclosing frame. The filter shall be listed as Underwriters' Laboratories Class 2 (or Class 1).
- B. The media shall have an average efficiency of 25-30% (MERV 11) when tested under ASHRAE Standard 52.1-1992 (52.2-1999).
 - 1. For 1 inch deep filters, the effective filter media shall be not less than 1.9 square feet of media per square foot of filter face area. There shall be not less than 14 pleats per linear foot of filter face area. Initial resistance at 500 feet per minute approach velocity shall not exceed 0.45" w.g. Filter shall be rated for a final pressure drop of not less than 1.0" w.g.
 - 2. For 2 inch deep filters, the effective filter media shall be not less than 4.4 square feet of media per square foot of filter face area. There shall be not less than 14 pleats per linear foot of filter face area. Initial resistance at 500 feet per minute approach velocity shall not exceed 0.30" w.g. Filter shall be rated for a final pressure drop of not less than 1.0" w.g.
 - 3. For 4 inch deep filters, the effective filter media shall be not less than 6.7 square feet of media per square foot of filter face area. There shall be not less than 10 pleats per linear foot of filter face area. Initial resistance at 600 feet per minute approach velocity shall not exceed 0.35" w.g. Filter shall be rated for a final pressure drop of not less than 1.0" w.g.
- C. The media support grid shall be constructed of a corrosion resistant expanded metal backing.
- D. The enclosing frame shall be constructed of a rigid, heavy-duty, high wet-strength beverage board. Diagonal support members, of the same construction, shall be bonded to the air entering and air exiting side of each pleat. The inside periphery of the enclosing frame shall be bonded to the filter pack eliminating the possibility of air bypass.
- E. The filter shall be identified on the enclosing frame as to manufacturer, model, and U.L. Class rating.

2.05 FILTER GAGES

- A. An Air Filter Gauge for measuring the resistance to airflow through the filters shall be installed. Each housing shall include one gauge (magnehelic type) for measurement of pre-filter, final filter, and/or total filter bank resistance.
- B. The air filter gauge shall be diaphragm actuated, shall have 3-7/8" diameter white dial with black figures and graduations, shall have zero adjustment, shall be furnished with two static pressure tips, fittings for 1/4" metal or plastic tubing, and a means for mounting the gauge. Gauge graduations shall be from 0"-3".

- C. A three-way gauge cock and fittings shall be provided to allow measurements relating to three tap locations.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install filter frames according to manufacturer's written instructions.
- B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- C. Install filters in position to prevent passage of unfiltered air.
- D. Install filter gage for each filter bank.
- E. Install filter gage static-pressure taps upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
- F. Coordinate filter installations with duct and air-handling unit installations.
- G. Electrical wiring and connections are specified in Division 26 Sections.
- H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, **test, and adjust** field-assembled components, filter and filter-frame installation, and electrical wiring, **and to assist in field testing**. Report results in writing.

3.03 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION

SECTION 23 51 13

DRAFT CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Barometric dampers.
 - 2. Vent dampers.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for fans and dampers. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For draft control devices to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

- A. 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.

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of vent exhaust fans barometric dampers or vent dampers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include failure of the fan due to corrosion.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 BAROMETRIC DAMPERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Babco Inc.
 - 2. Bramec Corporation.
 - 3. EXHAUSTO, Inc.
 - 4. Tjernlund Products, Inc.
 - 5. Tutco, Inc.
 - 6. Wing Draft Inducers.
- B. Damper Construction: High-temperature-enamel-painted steel damper and housing with galvanized-steel breeching connection. Adjustable counterweight with lock. Include knife-edge bearings that do not require lubrication.

2.02 VENT DAMPERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Effikal International Inc.
 - 2. Field Controls L.L.C.; Venting Solutions Company (The).
 - 3. Johnson Controls, Inc.; Controls Group.
- B. Damper Construction: Stainless-steel damper blade, shaft, and vent pipe with metal, prelubricated bearings.
 - 1. Electric motor sized to power damper open and closed in approximately 15 seconds in each direction. Power is off when damper is at rest.
 - 2. Comply with ANSI Z21.66.
- C. Controls:
 - 1. Control transformer.
 - 2. Keyed wiring harness.
 - 3. Damper end-switch to prove damper is open.
 - 4. Interlock with boiler to permit burner operation when damper is open.
 - 5. Hold-open switch for troubleshooting boiler controls.

2.03 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.04 CAPACITIES AND CHARACTERISTICS – Refer to the Drawings

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install listed components in a manner complying with the listing.

- B. Secure barometric dampers to breechings with hardware compatible with connected materials.
- C. Locate barometric and motorized vent dampers as close to draft hood collar as possible.
- D. Secure barometric and motorized vent dampers to appliances, breechings, or chimneys with hardware compatible with connected materials.
- E. Install intake duct that is sized according to manufacturer's written instructions.

3.02 CONNECTIONS

- A. Ground equipment according to Division 26.
- B. Connect wiring according to Division 26.

3.03 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
- B. Remove and replace malfunctioning components and recheck.

3.04 ADJUSTING

- A. Set field-adjustable switches and controls as indicated.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain draft control devices.

END OF SECTION

SECTION 23 81 26

SPLIT SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Split Air Conditioners.
- B. Controls.

1.02 RELATED SECTIONS:

- A. Section 23 05 00 – Basic Mechanical Materials and Methods
- B. Section 23 05 13 – Motors.
- C. Section 23 05 48 - Vibration Isolation and Seismic Controls.
- D. Section 23 07 00 - Mechanical Insulation.
- E. Section 23 23 00- Refrigerant Piping and Specialties
- F. Division 26 - Electrical: Equipment Wiring Systems - Electrical supply to units.

1.03 SUBMITTALS:

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Submit shop drawings and product data for manufactured and assemblies required of the project.
- C. Indicate drain and electrical rough-in connection on shop drawings or product data

1.04 WARRANTY:

- A. Provide a one year warranty to include coverage under provisions of Division 1.

1.05 EXTRA MATERIALS:

- A. Provide one set of filters for each unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. LG
- B. Mitsubishi
- C. Carrier.
- D. Approved Equal.

2.02 AIR CONDITIONING UNITS:

- A. Description: Packaged, self-contained, factory assembled, prewired unit, consisting of cabinet, compressor, condensing coil, evaporator fan, evaporator coil, air filters, controls, and remote condenser and refrigerant kit.

2.03 CABINET:

- A. Frame and Panels: Heavy gauge galvanized steel with baked enamel finish, easily removed access doors with positive latches, discharge and return grilles.
- B. Insulation: Minimum 1 inch thick acoustic duct liner for lining cabinet interior.
- C. Drain Pan: Galvanized steel with corrosion-resistant coating.

2.04 EVAPORATOR FAN:

- A. Fan: Direct drive, width, double inlet, forward curved centrifugal fan, statically and dynamically balanced, with permanently lubricated bearings.
- B. Motors: As indicated in compliance with Section 23 05 13.

2.05 COMPRESSOR:

- A. Compressors shall be heavy-duty, rotary, hermetic type with reversible, positive displacement oil pump, suction and discharge line service valves, crankcase heater and inherent-solid-state thermal overload protection. Each compressor shall have its own completely independent refrigeration circuit including sight glass, filter-drier, and manual shutoff. A spruse-type high pressure relief valve. Compressor shall be isolated on neoprene impregnated fiberglass kinetic block.

2.06 EVAPORATOR COIL:

- A. Direct expansion coiling coil of seamless copper to be expanded into aluminum fins. Provide each coil with an additional circuit for a minimum of 15 degrees of subcooling.

2.07 CONDENSER:

- A. Fan: propeller type statically and dynamically balanced, with permanently lubricated bearings.
- B. Motors: As indicated in compliance with Section 23 05 13.
- C. Provide with metal coil guard.

2.08 AIR FILTERS:

- A. Easily removed one inch thick disposable glass fiber panel filters.

2.09 CONTROLS:

- A. Unit shall be complete with a remote wall mounted micro processor based thermostat.

2.10 REFRIGERANT PIPING:

- A. Copper Tubing: ASTM B280, Type ACR hard drawn.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- B. Copper Tubing to 7/8 inch OD: ASTM B88, Type K, annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Pipe condensate from drain pan to condensate drainage system.

END OF SECTION

SECTION 26 00 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Electrical Requirements specifically applicable to Division 26 Sections, in addition to Division 1 General Requirements.

1.2 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work as required.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013000.
- B. Proposed Products List: Include Products specified in the following Sections:
 - 1. 260505 Selective Demolition For Electrical
 - 2. 260519 Low-Voltage Electrical Power Conductors And Cables
 - 3. 260522 Manufactured Wiring Assemblies
 - 4. 260526 Grounding And Bonding For Electrical Systems
 - 5. 260529 Hangers And Supports For Electrical Systems
 - 6. 260533 Raceway And Boxes For Electrical Systems
 - 7. 260536 Cable Trays For Electrical Systems
 - 8. 260553 Identification For Electrical Systems
 - 9. 262200 Low-Voltage Transformers
 - 10. 262416 Panelboards
 - 11. 262716 Electrical Cabinets And Enclosures
 - 12. 262726 Wiring Devices
 - 13. 262826 Enclosed Transfer Switches
 - 14. 262916 Enclosed Contactors
 - 15. 263213 Engine Generators
 - 16. 265150 Interior Lighting - Solid State Lighting (SSL)
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
- D. Mark dimensions and values in units to match those specified.

1.5 REGULATORY REQUIREMENTS

- A. Conform to Uniform Building Code.
- B. Electrical: Conform to NFPA 70.
- C. Electrical: Conform to local electrical ordinance.

- D. Obtain permits, and request inspections from authority having jurisdiction.

1.6 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. The drawings are diagrammatic unless indicated otherwise. The drawings reflect circuiting only and are not depicting exact conduit routing unless specifically noted otherwise. Homerun circuits may be combined per requirements of NEC. Do not share neutral conductors in Homeruns unless specifically noted on Drawings.
- C. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner before proceeding.
- D. Data presented on these drawings are as accurate as planning can determine, but field verification of all dimensions, locations, levels, etc., to suit field conditions is required. Review all architectural, interior, structural, civil, and mechanical drawings; and adjust all work to meet the requirements of conditions shown. Discrepancies between different plans or between drawings and specifications, or regulations and codes governing the installation shall be brought to the attention of the engineer in writing before the date of bid opening. If discrepancies are not reported, the contractor shall bid the greater quantity or better quality, and appropriate adjustments will be made after contract award. Contractor shall be responsible to field measure and confirm mounting heights and location of electrical equipment with respect to counters, radiation, etc. Do not scale distances off the electrical drawings. Use actual building and site dimensions.
- E. Guarantee all material furnished and all workmanship performed for a period of one year from the date of final acceptance of the work. Any defects developing within this period, traceable to material furnished as a part of this section or workmanship performed hereunder, shall be made good at no additional expense to the owner.

1.7 SEQUENCING AND SCHEDULING

- A. Construct Work in sequence under provisions of Section 01010.

PART 2 - PRODUCTS

\\Not Used

PART 3 - EXECUTION

\\Not Used

END OF SECTION

SECTION 26 05 05

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
 - 2. Disposal of materials.
 - 3. Storage of removed materials.
 - 4. Identification of utilities.
 - 5. Salvaged items.
 - 6. Protection of items to remain as indicated on drawings.
 - 7. Relocate existing equipment to accommodate construction.
- B. Related Sections:
 - 1. Section 024119 - Selective Structure Demolition: Removal of designated building equipment and construction.

1.2 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of capped capped conduits and equipment abandoned in place.
- C. QUALITY ASSURANCE
- D. Perform Work in accordance with Public Works standard.
- E. PRE-INSTALLATION MEETINGS
- F. Section 013000 - Administrative Requirements: Pre-installation meeting.
- G. Convene minimum one week prior to commencing work of this section.

1.3 SEQUENCING

- A. Section 011000 - Summary: Requirements for sequencing.
- B. Sequence work in the following order:
 - 1. Verify all electrical equipment, wiring devices, and wiring to be removed.
 - 2. Verify existing circuiting of equipment indicated to be removed and any equipment on common circuit that is to remain.
 - 3. Disconnect equipment indicated to be removed from existing circuit and provide for continuity of circuit to existing equipment indicated to remain.
 - 4. Provide protection for removed equipment and store in owner designated location.

1.4 SCHEDULING

- A. Section 013000 – Administrative Requirements: Requirements for scheduling.

- B. Schedule work to coincide with new construction and work of other trades.
- C. Perform demolition work:
 - 1. Between hours of 7:00am and 3:00pm.
- D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

1.5 COORDINATION

- A. Section 013000 - Administrative Requirements: Requirements for coordination.
- B. Conduct demolition to minimize interference with adjacent and occupied building areas.
- C. Coordinate demolition work with work of other trades.
- D. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- E. Shut-down Periods:
 - 1. Arrange timing of shut-down periods of in service panels with Owner. Do not shut down any utility without prior written approval.
 - 2. Keep shut-down period to minimum or use intermittent period as directed by Owner.
 - 3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum seven days in advance.
- F. Identify salvage items in cooperation with Owner.

PART 2 - PRODUCTS

2.1 Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- C. Verify termination points for demolished services.

3.2 PREPARATION

- A. Erect, and maintain temporary safeguards, including warning signs, barricades for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
- B. Temporary egress signage and emergency lighting

3.3 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect / Engineer before disturbing existing installation.

- B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces to match existing.
- C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation in accessible locations.
- D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- E. Reconnect equipment being disturbed by renovation work and required for continue service to the existing circuit or nearest designated panel.
- F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
- G. Install temporary wiring and connections to maintain existing systems in service during construction.
- H. Perform work on energized equipment or circuits with experienced and trained personnel.
- I. Remove, relocate, and extend existing installations to accommodate new construction.
- J. Repair adjacent construction and finishes damaged during demolition and extension work.
- K. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including components abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
- L. Clean and repair existing equipment to remain, affected by demolition work, or to be re-installed.
- M. Protect and retain power to existing active equipment remaining.
- N. Identify abandoned empty conduit at both ends as "abandoned".

3.4 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, use available "spare" circuit breakers or install new breakers.
- B. Identify unused circuits as spare on the updated panelboard directory.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated (Typed) directories where more than three circuits have been modified or rewired.

3.5 SALVAGE ITEMS

- A. Remove and protect items indicated on drawings or scheduled in this specification section to be salvaged and turn over to Owner.

- B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.6 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove and clean equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
- C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.7 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove demolished materials as work progresses. Legally dispose.
- C. Keep workplace neat on a daily basis.

3.8 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not permit traffic over unprotected floor surface.
- C. SCHEDULES
- D. Remove, store and protect the following materials and equipment:
 - 1. Light fixtures.
 - 2. Laboratory equipment.
- E. Remove the following equipment for Owner's retention. Deliver to location designated by Owner:
 - 1. Lighting fixtures.

END OF SECTION

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes building wire and cable; metal clad cable; and wiring connectors and connections.
- B. Related Sections:
 - 1. Section 26 05 53 - Identification for Electrical Systems: Product requirements for wire identification.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
 - 1. UL 1277 – Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than 14 AWG for control circuits.
 - 5. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet and shorter than 149 feet.
 - 6. 8 AWG conductors for 20 ampere, 120 volt branch circuits longer than 150 feet.
 - 7. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet and shorter than 329 feet.
 - 8. 8 AWG conductors for 20 ampere, 277 volt branch circuits longer than 330 feet.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only building wire, Type THW, THHN/THWN, XHHW insulation, in raceway or metal clad cable.
 - 2. Exposed Dry Interior Locations: Use only building wire, Type THW, THHN/THWN, XHHW insulation, in raceway or metal clad cable.
 - 3. Above Accessible Ceilings: Use only building wire, Type THW, THHN/THWN, XHHW insulation, in raceway, or metal clad cable.
 - 4. Wet or Damp Interior Locations: Use only building wire, Type THW, THHN/THWN, XHHW, insulation in raceway.
 - 5. Exterior Locations: Use only building wire, Type THW, THHN/THWN, XHHW, insulation in raceway.
 - 6. Underground Locations: Use only building wire, Type THW, THHN/THWN, XHHW, insulation in raceway.

- C. Metal Clad (MC) Cable may not be used.
- 1.4 DESIGN REQUIREMENTS
- A. Conductor sizes are based on copper.
 - B. Aluminum conductors are not allowed.
- 1.5 SUBMITTALS
- A. See Division 1 for Submittal Procedures.
 - B. Product Data: Submit for building wire and each cable assembly type.
 - C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
 - D. Test Reports: Indicate procedures and values obtained.
- 1.6 CLOSEOUT SUBMITTALS
- A. See Division 1 for Submittal Procedures for Execution and Closeout Requirements: Requirements for submittals.
 - B. Project Record Documents: Record actual locations of components and circuits.
- 1.7 QUALITY ASSURANCE
- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
 - B. Perform Work in accordance with NECA's Standard of Installation and in accordance with recognized industry practices.
- 1.8 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- 1.9 FIELD MEASUREMENTS
- A. Verify field measurements are as indicated on Drawings.
- 1.10 COORDINATION
- A. See Division 1 Administrative Requirements for Coordination and Project Conditions.
 - B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
 - C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Southwire Company.
 - 2. Okonite.
 - 3. Cable C.
 - 4. American Insulated Wire.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Single conductor insulated wire.
- C. Insulation: 600 volt rating; material rated 75 degrees C.
- D. Insulation Voltage Rating: 600 volts.
- E. Material: copper.

2.2 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger. Color keyed, compression type copper, with insulating sealing collars.

PART 3 EXECUTION

3.1 EXAMINATION

- A. See Division 1 Administrative Requirements for Coordination and Project Conditions.
- B. Verify interior of building has been protected from weather.
- C. Verify mechanical work likely to damage wire and cable has been completed.
- D. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods as specified.

- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques-Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques - Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- F. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Each tap, joint, or splice in conductors No. 4 AWG and larger shall be taped with a minimum of two layers of rubber compound tape and three layers of vinyl plastic electrical tape and a finish wrap of color coding tape, where required by code. Insulation of splice shall match or exceed insulation level of conductors.
 - 4. Cable splices shall be made only in distribution and junction boxes.
 - 5. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturers published torque tightening requirements. If not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B.
 - 6. Splices shall not be made in feeders.
 - 7. Terminate aluminum conductors with tin-plated, aluminum-bodied compression connectors only. Fill with anti-oxidant compound before installing conductor.
 - 8. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
- G. Install solid conductor for feeders and branch circuits 10 AWG and smaller.
- H. Use stranded conductor, No. 8 AWG and larger for general use wiring.
 - 1. Use stranded conductor, No. 12 AWG and larger, for motors and other installations where vibration is generated and for wiring to manufactured equipment.
 - 2. Use stranded conductor, No. 14 AWG minimum for control wiring.
 - 3. Install crimp on fork terminals for stranded conductor device terminations. Do not place bare stranded conductors directly under screws.
- I. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- J. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wire 4 AWG and larger to copper bus bars.
- K. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.5 WIRE COLOR

- A. General:
 - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Brown, orange, and yellow for circuits at 277/480 volts single or three phase.
 - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Brown, orange, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors:
 - 1. White for 120/208 and gray for 277/480 volt circuits. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
 - 2. Each circuit shall be provided with a dedicated neutral unless otherwise noted on the drawings.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.
 - 3. For isolated ground circuits: Green with yellow stripe.

3.6 FIELD QUALITY CONTROL

- A. See Division 1 for Quality control requirements and for execution of Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

SECTION 26 05 22

MANUFACTURED WIRING ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes prefabricated flexible cables, distribution units, and cable accessories for system of wiring using manufactured wiring assemblies.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Receptacle and wall switch outlets.
 - 2. Section 26 27 26 - Wiring Devices: Convenience receptacles and wall switches.
 - 3. Section 26 51 00 - Interior Lighting: Fixture connector assemblies.

1.2 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.3 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Shop Drawings: Indicate distribution box, switch box, outlet, and cable layout and branch circuit configuration.
- C. Product Data: Submit catalog data for each cable type and for each fitting and accessory.

1.4 CLOSEOUT SUBMITTALS

- A. See Division 1 Submittal Procedures for Execution and Closeout Requirements.
- B. Project Record Documents: Record actual locations of cable assemblies and branch circuits.

1.5 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
- B. Perform Work in accordance with NECA's Standard of Installation.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.
- B. Drawings:

1. Drawings are diagrammatic and should not be scaled to determine exact locations. Verify all locations and requirements of equipment furnished and/or installed by others before roughing in.
2. Any costs resulting from errors or omissions caused by this Contractor not verifying the above information will be borne by this Contractor at no expense to the Owner.
3. Any discrepancies noted on the drawings shall be identified by the Contractor during bidding. Contractor shall use the more stringent requirement and cost to establish a bid price.
4. Any conflicts between drawings and drawing schedules shall be brought to the Engineer's attention prior to submission of bid. Any such conflicts discovered at a later date shall be resolved at the Owner's discretion at the expense of the Contractor.

1.8 COORDINATION

- A. See Division 1 Administrative Requirements for Coordination and Project Conditions.
- B. Furnish luminaire connectors to luminaire manufacturer for factory installation.

PART 2 PRODUCTS

2.1 MANUFACTURED WIRING ASSEMBLIES

- A. Manufacturers:
 1. Electro/Connect Division of Emerson Electric Company.
 2. American Modular Systems Designs, Inc.
 3. Lithonia Reloc.
 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Factory assembled cable assemblies with appropriate connector on each end, with lengths and circuit configurations as indicated on Drawings.
- C. Switching Unit Assemblies: Furnish cables configured for 2-way, 3-way and 4-way switches where required. Voltage: 120 volts.
- D. Convenience Receptacle Unit Assemblies: Furnish cables configured to match device type. Voltage: 120 volts.
- E. Luminaire Connector Assemblies: Connector suitable for mounting in luminaire body knockout. Voltage: 120 volts.

2.2 DISTRIBUTION UNITS

- A. Manufacturers:
 1. Electro/Connect Division of Emerson Electric Company.
 2. American Modular Systems Designs, Inc.
 3. Lithonia Reloc.
 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Boxes suitable for terminating building wiring system raceways and making connections to integral receptacles; circuit configuration as indicated on Drawings.

2.3 ACCESSORIES

- A. Furnish manufacturer's standard accessories, including cable extenders, distribution tees, and switching assemblies.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove exposed abandoned cable and accessories, including abandoned components above accessible ceiling finishes.
- B. Disconnect and remove abandoned cable. Remove abandoned cable when boxes being serviced are abandoned and removed.
- C. Maintain access to existing distribution boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- D. Extend existing cable installations using materials and methods as specified.
- E. Clean and repair existing cable and accessories to remain or to be reinstalled.

3.2 INSTALLATION

- A. Support cable by means of straps and clamps.
- B. Support cable above suspended ceiling from structure to avoid contact with and interference with removal of ceiling panels. Do not support from ceiling suspension system.
- C. Arrange cable to avoid interference with access to other Work.
- D. Install each cable with 10 percent slack length.

END OF SECTION

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rod electrodes.
 - 2. Active electrodes.
 - 3. Wire.
 - 4. Grounding well components.
 - 5. Mechanical connectors.
 - 6. Exothermic connections.
- B. Related Sections:
 - 1. Section 03 20 00 - Concrete Reinforcing: Bonding or welding bars when reinforcing steel is used for electrodes.
 - 2. Section 09 69 00 - Access Flooring: Grounding systems for access flooring.
 - 3. Section 26 41 00 - Facility Lightning Protection: Grounding of lightning protection system.
 - 4. Section 33 79 00 - Site Grounding: Site related grounding components for buildings and facilities.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 99 - Standard for Health Care Facilities.

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal building frame.
 - 2. Concrete-encased electrode.
 - 3. Ground ring specified in Section 33 79 00.
 - 4. Rod electrode.
 - 5. Metal underground water pipe.

1.4 DESIGN REQUIREMENTS

- A. Construct and test grounding systems for access flooring systems on conductive floors accordance with IEEE 1100. Refer to Section 09 69 00.

1.5 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms maximum.

- 1.6 SUBMITTALS
- A. See Division 1 for Submittal Procedures.
 - B. Product Data: Submit data on grounding electrodes and connections.
 - C. Test Reports: Indicate overall resistance to ground [and resistance of each electrode].
 - D. Manufacturer's Installation Instructions: Submit for active electrodes.
 - E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- 1.7 CLOSEOUT SUBMITTALS
- A. See Division 1 Submittal Procedures for execution and Closeout Requirements.
 - B. Project Record Documents: Record actual locations of components and grounding electrodes.
- 1.8 QUALITY ASSURANCE
- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
 - B. Perform Work in accordance with NECA's Standard of Installation.
- 1.9 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
 - B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience approved by manufacturer.
- 1.10 PRE-INSTALLATION MEETINGS
- A. See Division 1: Administrative Requirements: Pre-installation meeting.
 - B. Convene minimum one week prior to commencing work of this section.
- 1.11 DELIVERY, STORAGE, AND HANDLING
- A. See Division 1 for Product Storage and Handling Requirements.
 - B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
 - C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
 - D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.
- 1.12 COORDINATION
- A. See Division 1 Administrative Requirements for Coordination and Project Conditions.
 - B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. O-Z Gedney Co.
 - 5. Thomas & Betts, Electrical.
 - 6. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description:
 - 1. Material: Copper.
 - 2. Diameter: 3/4 inch.
 - 3. Length: 10 feet.
- C. Connector: Connector for exothermic welded connection.

2.2 ACTIVE ELECTRODES

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. O-Z Gedney Co.
 - 5. Thomas & Betts, Electrical.
 - 6. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description:
 - 1. Material: Metallic-salt-filled copper-tube electrode.
 - 2. Shape: As indicated on Drawings.
 - 3. Length: feet.
 - 4. Connector: Connector for exothermic welded connection.

2.3 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: 4 AWG unless indicated on drawings.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

2.4 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8 inches NPS (DN200) by 24 inches (600 mm) long concrete pipe with belled end.
- B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.5 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.

3. Erico, Inc.
4. O-Z Gedney Co.
5. Thomas & Betts, Electrical.
6. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

- B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.6 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 1. Apache Grounding/Erico Inc.
 2. Cadweld, Erico, Inc .
 3. Copperweld, Inc.
 4. ILSCO Corporation.
 5. O-Z Gedney Co.
 6. Thomas & Betts, Electrical.
 7. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.1 EXAMINATION

- A. See Division 1: Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.4 INSTALLATION

- A. Install in accordance with IEEE 142.
- B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground. Drive ground rods to a depth of 12" below finished grade.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding well pipe with cover at rod locations as indicated on Drawings. Install well pipe top flush with finished grade.
- E. Install 4 AWG unless noted otherwise bare copper wire in foundation footing.

- F. Install grounding electrode conductor and connect to reinforcing steel in foundation footing as indicated on Drawings. Electrically bond steel together.
- G. Bond together metal siding not attached to grounded structure; bond to ground.
- H. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- I. Install ground grid under access floors. Construct grid of 4 AWG bare copper wire installed on 24 inch centers both ways. Bond each access floor pedestal to grid.
- J. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Install 4 AWG bare copper bonding conductor.
- K. Install isolated grounding conductor for circuits indicated on drawings in accordance with IEEE 1100.
- L. Install grounding and bonding in patient care areas to meet requirements of NFPA 99.
- M. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- N. Connect to site grounding system. Refer to Section 33 79 00.
- O. Bond to lightning protection system. Refer to Section 26 41 00.
- P. Install continuous grounding using building steel as grounding electrode. Install artificial station ground by means of driven rods or buried electrodes.
- Q. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- R. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- S. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed conductor to grounding bus.
- T. Ground electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- U. Permanently attach equipment and grounding conductors prior to energizing equipment.
- V. Except for connections to ground bus bars, all grounding conductor to conductor, conductor to ground rod and conductor to structure connections of #6 AWG and larger copper conductors shall be permanent exothermically welded connections. Copper grounding conductors spliced with exothermic connections shall be considered as a continuous conductor, as stated in NEC 250-64(c).
- W. Attach grounds to ground bus bars before permanent building service is energized.

- X. Ground metal lighting poles, as shown on drawings and as required by NEC.
- Y. When installing exposed runs, attach ground wire neatly and firmly to walls.
- Z. Step-down transformer secondaries shall be grounded to the nearest electrical room ground bus bar. Also, bond the grounded conductor of the transformer to the nearest available point of the interior metal water piping system in the area served by the transformer in accordance with NEC Article 250-104.
- AA. Feeders to remote buildings shall have their equipment grounding conductors bonded in accordance with NEC Article 250-32.
- BB. The equipment grounding terminal bars of the normal and emergency electrical system panelboards that serve the same patient area shall be bonded together with an insulated continuous copper conductor not smaller than No. 8
- CC. Panelboards serving "critical care" areas shall be grounded in accordance with NEC Article 517-19 (d). Metal feeder raceways shall have grounding bushing and a continuous copper bonding jumper sized in accordance with NEC Table 250-122.
- DD. Bond fuel storage tanks and associated metallic piping systems to building ground system.
- EE. Bond bulk oxygen storage tank and associated metallic piping system to building ground system.
- FF. All grounding conductors exposed shall be enclosed in conduit. All conductors within conduit shall be insulated.
- GG. All bare grounding conductors shall be secured with connectors rated for connection to exposed similar metals.

3.5 FIELD QUALITY CONTROL

- A. See Division 1 for Quality Control Requirements and for execution of field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground resistance testing in accordance with IEEE 142.
- E. Perform leakage current tests in accordance with NFPA 99.
- F. Perform continuity testing in accordance with IEEE 142.
- G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
 - 2. Section 27 05 29 - Hangers and Supports for Communications Systems.
 - 3. Section 28 05 29 - Hangers and Supports for Electronic Safety and Security.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- B. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 5. UL - Fire Resistance Directory.
- E. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH - Certification Listings.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263 and UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
 - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Surface Burning: ASTM E84 and UL 723 with maximum flame spread / smoke developed rating of 25/450.
- C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of hangers and supports.
- F. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

- B. Through Penetration Firestopping of Non-Fire Rated Floor [and Roof] Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with requirements of local jurisdiction.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience approved by manufacturer.

1.9 PRE-INSTALLATION MEETINGS

- A. See Division 1 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. See Division 1 for Product Storage and Handling Requirements.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. See Division 1 Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company.
 - 3. O-Z Gedney Co.
 - 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division.
 - 4. Unistrut Corp.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

2.3 SPRING STEEL CLIPS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division.
 - 4. Unistrut Corp.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Mounting hole and screw closure.

2.4 SLEEVES

- A. Furnish sleeves and seals, including armored cable seals, of types, sizes, and materials with the following construction features.
- B. Sleeves for Through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.
- C. Sleeves for Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- D. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

- E. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation.
 - 3. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
 - 4. Advance Products & Systems, Inc.
 - 5. Calpico, Inc.
 - 6. Metraflex Co.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products.
 - 6. Specified Technology, Inc.
 - 7. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray.

2.7 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.

- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. See Division 1 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing and damming materials to arrest liquid material leakage.
- D. Obtain permission from Structural Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors and preset inserts.
 - 2. Steel Structural Elements: Provide beam clamps and welded fasteners.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
 4. Support vertical conduit at every floor.
- G. Placement of Hangers and Supports onto structural steel shall be coordinated with the structural engineer.

3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- F. Place intumescent coating in sufficient coats to achieve rating required.
- G. Remove dam material after firestopping material has cured.
- H. Fire Rated Surface:
 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 2. Where cable tray, bus, cable bus, conduit, wireway, or trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- I. Non-Rated Surfaces:
 1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:

- a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
- b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
- c. Install type of firestopping material recommended by manufacturer.
- 2. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
- 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
- 4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches (87 mm) thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Section 03 30 00.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. See Division 1 for Quality Control Requirements and for execution of field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications.

3.8 CLEANING

- A. See Division 1 Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

- A. See Division 1 for Execution and Closeout Requirements for protecting installed construction.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
 - 1. Section 26 05 03 - Equipment Wiring Connections.
 - 2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 3. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 4. Section 26 05 34 - Floor Boxes for Electrical Systems.
 - 5. Section 26 05 36 - Cable Trays for Electrical Systems.
 - 6. Section 26 05 39 - Underfloor Raceways for Electrical Systems.
 - 7. Section 26 05 53 - Identification for Electrical Systems.
 - 8. Section 26 27 16 - Electrical Cabinets and Enclosures.
 - 9. Section 26 27 23 - Indoor Service Poles.
 - 10. Section 26 27 26 - Wiring Devices.
 - 11. Section 27 05 33 - Conduits and Backboxes for Communications Systems.
 - 12. Section 27 05 36 - Cable Trays for Communications Systems.
 - 13. Section 28 05 33 - Conduits and Backboxes for Electronic Safety and Security.
 - 14. Section 28 05 36 - Cable Trays for Electronic Safety and Security.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground: Provide thickwall nonmetallic conduit. Provide cast metal boxes or nonmetallic handhole.

- C. In or Under Slab on Grade: Provide thickwall nonmetallic conduit. Provide cast or nonmetallic metal boxes.
- D. Outdoor Locations, Above Grade: Provide rigid steel and aluminum conduit, intermediate metal conduit and electrical metallic tubing. Provide cast metal or nonmetallic outlet, pull, and junction boxes.
- E. In Slab Above Grade: Provide rigid steel conduit, intermediate metal conduit and electrical metallic tubing. Provide sheet metal boxes.
- F. Wet and Damp Locations: Provide rigid steel and aluminum conduit, intermediate metal conduit and electrical metallic tubing. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- G. Concealed Dry Locations: Provide rigid steel and aluminum conduit, intermediate metal conduit and, electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- H. Exposed Dry Locations: Provide rigid steel and aluminum conduit, intermediate metal conduit, and electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 1/2 inch unless otherwise specified. All homeruns to panelboards shall be minimum size 3/4 inch.

1.5 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Product Data: Submit for the following:
 - 1. Flexible metal conduit.
 - 2. Liquidtight flexible metal conduit.
 - 3. Nonmetallic conduit.
 - 4. Flexible nonmetallic conduit.
 - 5. Raceway fittings.
 - 6. Conduit bodies.
 - 7. Surface raceway.
 - 8. Wireway.
 - 9. Pull and junction boxes.
 - 10. Handholes.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

- A. See Division 1: Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents:
 - 1. Record actual routing of conduits larger than 2 inch.
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Division 1: Product Requirements: Product storage and handling requirements.

- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.8 COORDINATION

- A. See Division 1: Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

2.1 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; all steel fittings.

2.2 PVC COATED METAL CONDUIT

- A. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked steel construction.
- B. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked steel construction with PVC jacket.
- B. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Product Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression or set screw type.

2.6 NONMETALLIC CONDUIT

- A. Product Description: NEMA TC 2; Schedule 40 and 80 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.7 SURFACE METAL RACEWAY

- A. Manufacturers:
 - 1. Thomas & Betts Corp. Model SR600VCB.
 - 2. The Wiremold Co. Model V4000.
 - 3. Mono Systems. Model SMS4200.
 - 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- C. Size: As indicated on drawings.
- D. Finish: Ivory enamel.
- E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.
- F. Receptacles: Provide only metallic device plates with overlap edges and accessories to accept convenience receptacles specified in Section 26 05 34.
 - 1. Single Duplex #V4048B – OL
 - 2. Duplex / Data #V4048BF – OL
- G. Receptacle Color: Ivory.

2.8 WIREWAY

- A. Product Description: General purpose type wireway.
- B. Knockouts: Manufacturer's standard.
- C. Size: As indicated on Drawings.
- D. Cover: Hinged.
- E. Connector: Slip-in.
- F. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.9 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch (13 mm) male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- D. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- E. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.10 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 26 07 16.
- C. Concrete composite Handholes: Concrete composite hand holes:
 - 1. Cable Entrance: Pre-cut 6 inch x 6 inch (150 mm x 150 mm) cable entrance at center bottom of each side.
 - 2. Cover: Concrete composite, weatherproof cover with nonskid finish.
 - 3. Cover Legend: "Electric".

PART 3 EXECUTION

3.1 EXAMINATION

- A. See Division 1 Administrative Requirements: Coordination and project conditions.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Conceal raceway except in mechanical or utility areas and where noted exposed.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.

- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 3/4 inch. Do not cross conduits in slab.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate or factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Close ends and unused openings in wireway.
- X. All elbows shall be Rigid Galvanized Steel with 40 mil plastic coating (1/2 lap 20 mil plastic tape is also acceptable).
- Y. All conduits penetrating slabs whether exposed or not shall be rigid galvanized steel.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as specified in section for outlet device.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches (150 mm) separation. Install with minimum 24 inches (600 mm) separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

3.6 SURFACE MOUNTED RACEWAY INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.
- C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- D. Wireway Supports: Provide steel channel as specified in Section 26 05 29.
- E. Close ends of wireway and unused conduit openings.
- F. Ground and bond raceway and wireway under provisions of Section 26 05 26.
- G. Mount at 30" to bottom from finished floor in all classrooms.
- H. All exposed conduit in occupied areas shall be surface mounted raceway.

- I. Use factory supplied tools for cutting of base and covers. Use Wiremold Catalog Number 640B for base cuts, Wiremold Catalog Number 640C for cover cuts, and Wiremold Catalog Number 605 for V500 raceway cuts. Do not use saw cuts for field cutting.
- INTERFACE WITH OTHER PRODUCTS

- I. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.
- J. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.
- K. Flexible conduit only to be use to make final connections to vibrating equipment as required per code not to exceed 10'.
- L. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- M. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

- A. See Division 1 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.8 CLEANING

- A. See Division 1 Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes cable tray.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 29 - Hangers and Supports for Electrical Systems.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- B. National Electrical Manufacturers Association:
 - 1. NEMA FG 1 - Nonmetallic Cable Tray Systems.
 - 2. NEMA VE 1 - Metal Cable Tray Systems.
 - 3. NEMA VE 2 - Metal Cable Tray Installation Guidelines.

1.3 SUBMITTALS

- A. See Division 1 for Submittal procedures.
- B. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.
- C. Product Data: Submit fittings and accessories.
- D. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 CLOSEOUT SUBMITTALS

- A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.5 QUALIFICATIONS

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

1.6 PRE-INSTALLATION MEETINGS

- A. See Division 1 Administrative Requirement: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

PART 2 PRODUCTS

2.1 METAL LADDER-TYPE CABLE TRAY

- A. Manufacturers:
 - 1. Wiremold.
 - 2. B-Line.
 - 3. T.J. Cope Inc.
 - 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA VE 1, Class 20C ladder type tray.
- C. Material: Steel or Aluminum.
- D. Finish: Galvanized to ASTM A123/A123M; minimum 1.2 oz/sq ft 355 coating thickness; galvanize after fabrication.
- E. Inside Width: As indicated on Drawings.
- F. Inside Depth: As indicated on Drawings.
- G. Straight Section Rung Spacing: 6 inches on center.
- H. Inside Radius of Fittings: as indicated on Drawings.
- I. Furnish manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- J. Covers: Flanged, solid flush cover.

2.2 METAL TROUGH-TYPE CABLE TRAY

- A. Manufacturers:
 - 1. Wiremold.
 - 2. B-Line.
 - 3. T.J. Cope Inc.
 - 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA VE 1, Class 20C ventilated trough type cable tray.
- C. Material: Steel Aluminum.
- D. Finish: ASTM A123/A123M, hot dipped galvanized after fabrication.
- E. Inside Width: 12 inches minimum.
- F. Inside Depth: 3 inches minimum.
- G. Inside Radius of Fittings: 12 inches minimum.
- H. Furnish manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- I. Covers: Flanged, solid flush cover.

2.3 METAL SOLID-BOTTOM-TYPE CABLE TRAY

- A. Manufacturers:
 - 1. Wiremold.
 - 2. B-Line.
 - 3. T.J. Cope Inc.
 - 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA VE 1, Class 20C solid-bottom cable tray.
- C. Material: Steel or Aluminum.
- D. Finish: ASTM A123/A123M, hot dipped galvanized after fabrication.
- E. Inside Width: 12 inches minimum.
- F. Inside Depth: 4 inches or as indicated on Drawings.
- G. Inside Radius of Fittings: 12 inches or as indicated on Drawings.
- H. Furnish manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- I. Covers: Flanged, solid flush cover.

2.4 CENTER AND WALL SUPPORTED CABLE TRAY

- A. Manufacturers:
 - 1. Wiremold Company Model Spec Mate Center Spine and Wall Mount.
 - 2. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description:
 - 1. The tray shall be constructed of 6063 T6 aluminum alloy and shall utilize a center spine with center lines to indicate all areas where after field cutting of tray, new holes need to be drilled or screws inserted. The standard 3" deep bottom rung tray in which the spine acts to separate the cable compartments, shall offer a full 3" wall separating each compartment. When 4" and 6" rungs are used, a divider strip should be placed on top of the spine to provide a full barrier and the threaded rod should be sleeved.
 - 2. Center Supported Tray:
 - a. The Cable tray shall be constructed to form open and accessible compartments to hold the necessary cables which will also enable full viewing of same. The tray shall be center hung allowing cable lay in where applicable.
 - b. The tray shall be constructed with two components, (1) the center spine and (2) the rung. The spine is a single aluminum extrusion containing two hollows. The upper or vertical hollow provides surface to mount the splice connector and hanger rod. The lower or horizontal hollow has wings extending left and right which provide extra support for the rungs.
 - c. The rungs shall have a 1" cable laying surface and be placed horizontally along the spine on 6" centers. The end of the rungs shall be bent upward to a height of 6" forming a 90-degree angle, creating a cable laying area between the spine and the vertical portion of the rung. The rung shall be designed with a center screw groove along its length to provide a direct connection for rung mounted accessories. The ends of all rungs shall be fitted with a plastic cap to prevent damage to the cable and injury to the installer. The rungs shall be field removable and replaceable, enabling the avoidance of obstructions during installation and easy restructuring of

- d. the system should future alterations become necessary. The interchangeable rungs shall offer future expansion of the tray capacity without removal of cables or the existing spine.
 - e. The tray must offer an open view of the cables and be free of side rails.
 - e. Cable tray shall be 12" (18") wide.
- 3. Wall Mounted Tray:
 - a. The cable tray shall be constructed to form an open and accessible compartment to hold the necessary cables which will also enable full viewing of same. The tray shall be wall mounted allowing cable lay in where applicable.
 - b. The tray shall be constructed with two components, (1) the main support which is the spine and (2) the rungs. The spine is a single aluminum extrusion designed with a lower cavity, which has extending wings and provides 1-5/16" rung support.
 - c. The rungs shall have a 1" cable laying surface and be attached on 6" centers. They shall protrude from the spine on only one side. The end of the rungs shall be bent upward to a height of 6" forming a 90-degree angle, creating a cable laying area between the spine and the vertical portion of the rung. The rung shall be designed with a center screw groove along its length to provide a direct connection for rung mounted accessories. The ends of all rungs shall be fitted with a plastic cap to prevent damage to the cable and injury to the installer.
 - d. The tray must not have side rails and must offer an open view of the cables.
 - e. Cable tray shall be 12" wide.
- 4. A full complement of fittings for the cable tray shall be available including, but not limited to, 45 and 90 degree flat, vertical inside and outside elbows, tee and cross fittings, couplings for joining sections of the tray, hangers, end blanks, a field-installed divider and all other components necessary to make the system workable. The fittings and accessories shall be of compatible material.

2.5 WARNING SIGNS

- A. Engraved Nameplates: 1/2 inch (13 mm) black letters on yellow laminated plastic nameplate, engraved with: WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove exposed abandoned cable tray, including abandoned cable tray above accessible ceiling finishes. Remove supports. Cut cable tray flush with walls and floors, and patch surfaces.
- B. Maintain access to existing cable tray and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Extend existing cable tray installations using materials and methods, existing electrical installations, or as specified.
- D. Clean and repair existing cable tray to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install metal cable tray in accordance with NEMA VE 2.
- B. Install fiberglass cable tray in accordance with NEMA FG 1.

- C. Support trays and fasten to structure and finishes in accordance with Section 26 05 29. Install supports at each connection point, at end of each run, and at other points to maintain spacing between supports per manufacturers requirements.
- D. Install expansion connectors where recommended by manufacturer.
- E. Install firestopping in accordance with Section 26 05 29 to sustain ratings when passing cable tray through fire-rated elements.
- F. Ground and bond metal cable tray in accordance with Section 26 05 26.
 - 1. Provide continuity between tray components.
 - 2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
 - 3. Install 2 AWG bare [copper] [aluminum] equipment grounding conductor through entire length of tray; bond to each component.
 - 4. Make connections to tray using mechanical, compression or exothermic connectors.
- G. Install warning signs at 50 feet (1500 mm) centers along cable tray, located to be visible.
- H. Prior to and during installation, refer to system layout or approval drawings containing all elements of the system. Install shall comply with complete system instruction sheets.
- I. All enclosures shall be mechanically continuous and connected to adjacent conduit and wiring systems.
- J. Center supported tray shall be supported to structure on 6' centers by a single half inch threaded rod which either passes through the vertical hole in the splice connector or a hole drilled vertically through the spine.
- K. Wall mounted tray shall be supported on a minimum of 4' centers by three mounting brackets that allow the spine to be temporarily held in place with snap-on covers, until they can be secured to the wall bracket with sheet metal screws.
- L. Provide all required transition fittings to transition from center supported tray to wall mounted tray, so that tray is on a continuous run.
- M. All connections shall be checked to make sure they are correctly tightened and to ensure that all enclosures are electrically continuous and bonded with adjacent systems in accordance with the National Electric Code for proper grounding.
- N. All systems shall be installed complete. Work shall include fastening all enclosures to adjacent wiring systems to install a complete system as indicated on the electrical and/or communication drawings and in the applicable specifications.
- O. Allow sufficient space surrounding tray to permit access for installing and maintaining cables.
- P. Coordinate location of cable tray with mechanical ducts and piping of other trades as required.
- Q. Conduits stubbed to cable tray shall be attached to tray using conduit bushing dropout fittings.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.
- B. Related Sections:
 - 1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.
 - 2. Section 27 05 53 - Identification for Communications Systems.
 - 3. Section 28 05 53 - Identification for Electronic Safety and Security.

1.2 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- C. Samples:
 - 1. Submit two samples of each type of identification products applicable to project.
 - 2. Submit two nameplates, [4 x 4] inch ([100 x 100] mm) in size illustrating materials and engraving quality.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

- A. See Division 1 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. See Division 1 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. See Division 1 Product Requirements: Environmental conditions affecting products on site.
- B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
- B. Letter Size:
 - 1. 1/8 inch high letters for identifying individual equipment and loads.
 - 2. 1/4 inch high letters for identifying grouped equipment and loads.
- C. Minimum nameplate thickness: 1/8 inch.

2.2 LABELS

- A. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

2.3 RECEPTACLES AND SWITCHES

- A. Description: Provide adhesive labels with panel name and circuit number.

2.4 WIRE MARKERS

- A. Description: Split sleeve or tubing type wire markers.
- B. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
 - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams and shop drawings.

2.5 CONDUIT AND RACEWAY MARKERS

- A. Description: Colored tape or paint to identify conduit by system. Adhesive label to identify conduit by voltage, width of color band to be minimum of 1" wide.
 - 1. Medium Voltage System: Black lettering on white background.
 - 2. 480 Volt System: Black lettering on white background.

3. 208 Volt System: Black lettering on white background.
4. Non-Emergency Power: Yellow.
5. Security: Purple.
6. Communication: Light Blue.
7. Fire Alarm System: Red.
8. Motor and Other Control Systems: Orange/Blue.
9. Telephone System: Black.
10. Emergency Power: Yellow/Red.
11. Category 5 Cable: Light Green.
12. Fiber Optic Cable: Dark Green.

B. Legend:

1. Medium Voltage System: HIGH VOLTAGE 4160/2400V.
2. 480 Volt System: 480 VOLTS. HIGH VOLTAGE.
3. 208 Volt System: 208 VOLTS.

2.6 UNDERGROUND WARNING TAPE

- A. Description: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches (184 x 75 mm).

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 EXISTING WORK

- A. Install identification on existing equipment to remain in accordance with this section.
- B. Install identification on unmarked existing equipment.
- C. Replace lost nameplates and labels.
- D. Re-stencil existing equipment.
- E. Paint conduits to identify system.

3.3 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 1. Install nameplate parallel to equipment lines.
 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, do not use adhesive.
 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
 4. Secure nameplate to equipment front using screws or rivets.

5. Secure nameplate to inside surface of door on recessed panelboard in finished locations with adhesive.
 6. Install nameplates for the following:
 - a. Switchboards.
 - b. Panelboards.
 - c. Transformers.
 - d. Service Disconnects.
 - e. Generators.
 - f. ATS.
- C. Label Installation:
1. Install label parallel to equipment lines.
 2. Install label for identification of individual control device stations, receptacles and data outlets.
 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.
 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 3. Install labels at data outlets identifying patch panel and port designation.
- E. Raceway Marker Installation:
1. Install raceway marker for each raceway longer than 6 feet.
 2. Raceway Marker Spacing: 50 feet on center.
 3. Raceway Painting: Identify conduit using field painting in accordance with Section 09 90 00.
 - a. Paint [colored band on] each conduit longer than 6 feet.
 - b. Paint bands 50 feet on center.
- F. Stencil Installation:
1. Apply stencil painting in accordance with Section 09 90 00.
- G. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried conduit, raceway, or cable and at 6 inches above conduit when installed deeper than 24 inches.

END OF SECTION

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes two-winding transformers; shielded transformers.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 2. Section 26 22 06 - Low-Voltage Transformer Load Centers.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
 - 2. NEMA ST 20 - Dry Type Transformers for General Applications.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

1.4 CLOSEOUT SUBMITTALS

- A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of transformers.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Division 1 - Product Requirements: Product storage and handling requirements.
- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

- A. Manufacturers:
 - 1. General Electric.
 - 2. Square D.
 - 3. Eaton Cutler-Hammer.
 - 4. Siemens.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated on Drawings.
- C. Primary Voltage: 480 volts, 3 phase.
- D. Secondary Voltage: 208Y/120 volts, 3 phase.
- E. Insulation system and average winding temperature rise for rated kVA as follows:
 - 1. 1-15 kVA: Class 185 with 115 degrees C rise.
 - 2. 16-500 kVA: Class 220 with 150 degrees C rise.
- F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
- G. Winding Taps:
 - 1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 15 kVA and Larger: NEMA ST 20.
- H. Sound Levels: NEMA ST 20.
- I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
- J. Ground core and coil assembly to enclosure by means of visible flexible Aluminum grounding strap.
- K. Mounting:
 - 1. 1-15 kVA: Suitable for wall mounting.
 - 2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 3. Larger than 75 kVA: Suitable for floor or trapeze mounting.
- L. Coil Conductors: Continuous Aluminum windings with terminations brazed or welded.
- M. Enclosure: NEMA ST 20, Type 1 ventilated. Furnish lifting eyes or brackets.
- N. Isolate core and coil from enclosure using vibration-absorbing mounts.
- O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 SHIELDED TRANSFORMERS

- A. Manufacturers:
 - 1. General Electric.
 - 2. Square D.

3. Eaton Cutler-Hammer.
 4. Siemens.
 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type shielded isolation transformers, ratings as indicated on Drawings.
- C. Primary Voltage: 480 volts, 3 phase.
- D. Secondary Voltage: 208Y/120 volts, 3 phase.
- E. Insulation system and average winding temperature rise for rated kVA as follows:
1. 10-15 kVA: Class 185 with 115 degrees C rise.
 2. 16-500 kVA: Class 220 with 150 degrees C rise.
- F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
- G. Winding Taps:
1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 2. Transformers 15 kVA and Larger: NEMA ST 20.
- H. Sound Levels: NEMA ST 20.
- I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
- J. Ground core and coil assembly to enclosure with visible flexible Aluminum grounding strap.
- K. Winding Shield: Electrostatic, with separate insulated grounding connection.
- L. Mounting:
1. 1-15 kVA: Suitable for wall mounting.
 2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
 3. Larger than 75 kVA: Suitable for floor or trapeze mounting.
- M. Coil Conductors: Continuous Aluminum windings with terminations brazed or welded.
- N. Enclosure: NEMA ST 20, Type 1, ventilated. Furnish lifting eyes or brackets.
- O. Isolate core and coil from enclosure using vibration-absorbing mounts.
- P. Nameplate: Include transformer connection data.
- 2.3 SOURCE QUALITY CONTROL
- A. Production test each unit according to NEMA ST20.
- PART 3 EXECUTION
- 3.1 EXAMINATION
- A. See Division 1 - Administrative Requirements: Coordination and project conditions.

- B. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, in accordance with Section 26 05 33, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Support transformers in accordance with Section 26 05 29.
 - 1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
 - 2. Wall/trapeze mounted to be at a minimum of 7'-6" AFF. If lower coordinate with engineer prior to rough in.
 - 3. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
 - 4. Mount trapeze-mounted transformers as indicated on Drawings.
 - 5. Installation hardware (rods, struts, etc.) are not to cover any equipment covers requiring removal for maintenance.
- D. Provide seismic restraints.
- E. Install grounding and bonding in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. See Division 1 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.4 ADJUSTING

- A. See Division 1 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes distribution and branch circuit panelboards, electronic grade branch circuit panelboards, [and load centers].
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 53 - Identification for Electrical Systems.
 - 3. Section 26 28 13 - Fuses.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 6. NEMA PB 1 - Panelboards.
 - 7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
- E. Underwriters Laboratories Inc.:
 - 1. UL 67 - Safety for Panelboards.
 - 2. UL 1283 - Electromagnetic Interference Filters.
 - 3. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement, sizes, and accessories.
- C. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

- A. See Division 1 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 MAINTENANCE MATERIALS

- A. See Division 1 - Execution and Closeout Requirements: Requirements for maintenance products.
- B. Furnish two of each panelboard key. Panelboards keyed alike.

PART 2 PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

- A. Manufacturers:
 - 1. Cutler Hammer.
 - 2. General Electric.
 - 3. Siemens.
 - 4. Square D.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Service Conditions:
 - 1. Temperature: 120 degrees F.
 - 2. Altitude: 2500 feet above sea level.
- D. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
- E. Minimum integrated short circuit rating: 22,000 amperes rms symmetrical for 208 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on Drawings.
- F. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- G. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
- H. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically

resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.

- I. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.
- J. Enclosure: NEMA PB 1, Type 1 [Minimum 5-3/4] inches deep, 20 inches wide, cabinet box. Minimum 16-gauge galvanized steel.
- K. Cabinet Front: Surface door-in-door type, fastened with concealed trim clamps, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
 - 1. Cutler Hammer.
 - 2. General Electric.
 - 3. Siemens.
 - 4. Square D.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper, current-carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard; furnish insulated ground bus as indicated on Drawings.
- D. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.
- E. Minimum Integrated Short Circuit Rating: 22,000 amperes rms symmetrical for 280 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on Drawings.
- F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- G. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
- H. Enclosure: NEMA PB 1, [Type 1] [Type 3R].
- I. Cabinet Box: Minimum 5-3/4 inches deep, 20 inches wide. Minimum 16-gauge.
- J. Cabinet Front: Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

2.3 ELECTRONIC GRADE PANELBOARD

- A. Integral Surge Suppressor:

1. Component recognized in accordance with UL 1449 and UL 1283.
2. Independently tested with category C3 high exposure waveform (20 kV-1.2/50us, 10kA-8/20 us) per IEEE C62.41.
3. Furnish copper bus bars for surge current path.
4. Construct using surge current modules (MOV based). Each module fused with user replaceable 200,000 AIR rated fuses. Status of each module monitored on front cover of panelboard enclosure and on module.
5. Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
6. Meet or exceed the following criteria:
 - a. Maximum single impulse current rating not less than 120 kA for each phase.
 - b. Pulse Lift Test: Capable of protecting against and surviving 5000 IEEE C62.41 Category C transients without failure or degradation.
 - c. Clamping voltage not exceeding the following:

Voltage	L-N	N-G	L-G
208Y/120	500 V	500 V	500 V
480Y/277	1000 V	1000 V	1000 V

7. Furnish response time no greater than five nanoseconds for individual protection modes.
8. Designed to withstand maximum continuous operating voltage (MCOV) of not less than 115 percent of nominal RMS voltage.
9. Furnish visible indication of proper suppresser connection and operation. Lights indicate operable phase and module.
10. Furnish minimum EMI/RFI filtering of 34 dB at 100 kHz with insertion loss ratio of 50: 1 using Mil Std. 220A methodology.

B. Panelboard:

1. UL 67 listed and TVSS device UL 1449 Component Recognized. TVSS device meets UL 1449. Furnish panelboard markings with clamp voltage at TVSS terminals and clamp voltage at panelboard line terminals.
2. Top or bottom feed as indicated on Drawings. Furnish circuit directory inside door.
3. Construct box of minimum 16-gauge galvanized steel. Box size as indicated on Drawings.
4. Main bus constructed of copper and rated for load current.
5. Furnish interior with branch circuit breakers. Furnish one circuit breaker, with appropriate number of poles, sized for dedicated disconnect for TVSS.
6. Furnish 200 percent rated neutral assembly with copper neutral bus.
7. Furnish with insulated ground bus and safety ground bus.
8. Furnish wiring gutters in accordance with NEC.
9. Field connections to panelboard: As indicated on drawings.
10. Construct with flush mounted trim and NEMA Type 1 enclosure.
11. Furnish with branch breaker positions and nominal current rating as indicated on Drawings.

2.4 LOAD CENTERS

A. Manufacturers:

1. Cutler Hammer.
2. General Electric.
3. Siemens.
4. Square D.

- 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Circuit breaker load center, with bus ratings as indicated on Drawings.
- C. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical.
- D. Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- E. Enclosure: General Purpose, minimum 16-gauge thickness.
- F. Box: Flush type with doors and lock on door. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect abandoned panelboards and load centers. Remove abandoned panelboards and load centers.
- B. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing panelboards and load centers to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet (1800 mm) to top of panelboard; install panelboards taller than 6 feet (1800 mm) with bottom no more than 4 inches (100 mm) above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
- G. Install engraved plastic nameplates in accordance with Section 26 05 53.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 3 empty 1 inch. Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

- A. See Division 1 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.4 ADJUSTING

- A. See Division 1 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 3. Section 27 05 33 - Conduits and Backboxes for Communications Systems.
 - 4. Section 28 05 33 - Conduits and Backboxes for Electronic Safety and Security.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.3 SUBMITTALS

- A. See Division 1 Submittal for procedures.
- B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALIFICATIONS

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

1.5 EXTRA MATERIALS

- A. See Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each key.

PART 2 PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Reliance Electric.
 - 4. Hoffman.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

- B. Construction: NEMA 250, Type 4 steel enclosure.
- C. Covers: Continuous hinge, held closed by hasp and staple for padlock.
- D. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- E. Enclosure Finish: Manufacturer's standard gray enamel.

2.2 CABINETS

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Reliance Electric.
 - 4. Hoffman.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Boxes: Galvanized steel.
- C. Box Size: 24 inches wide x 30 inches high x 6 inches deep.
- D. Backboard: Furnish 3/4 inch thick plywood backboard for mounting terminal blocks. Paint matte white.
- E. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- F. Knockouts: Manufacturer's standard top and bottom.
- G. Furnish metal barriers to form separate compartments wiring of different systems and voltages.
- H. Furnish accessory feet for free-standing equipment.

2.3 TERMINAL BLOCKS

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Reliance Electric.
 - 4. Square D.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Terminal Blocks: NEMA ICS 4.
- C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- E. Furnish ground bus terminal block, with each connector bonded to enclosure.

2.4 PLASTIC RACEWAY

- A. Manufacturers:

1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Reliance Electric.
4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: Plastic channel with hinged or snap-on cover.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove abandoned cabinets and enclosures, including abandoned cabinets and enclosures above accessible ceiling finishes. Patch surfaces.
- B. Maintain access to existing cabinets and enclosures and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Extend existing cabinets and enclosures using materials and methods as specified.
- D. Clean and repair existing cabinets and enclosures to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.
- B. Install cabinet fronts plumb.

3.3 CLEANING

- A. See Division 1 - Execution and Closeout Requirements: Final cleaning.
- B. Clean electrical parts to remove conductive and harmful materials.
- C. Remove dirt and debris from enclosure.
- D. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; multioutlet assembly; occupancy sensors; device plates; decorative box covers.
- B. Related Sections:
 - 1. Section 26 05 21 - Undercarpet Cable.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.
 - 3. Section 26 05 34 - Floor Boxes for Electrical Systems: Service fittings for receptacles installed on floor boxes.
 - 4. Section 26 05 34 - Floor Boxes for Electrical Systems: Poke-through receptacles.
 - 5. Section 26 05 39 - Underfloor Raceways for Electrical Systems: Service fittings for receptacles installed in underfloor raceways.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

- A. See Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each style, size, and finish for wall plate, switch, and receptacle.

1.6 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. IEEE Compliance:
 - a. IEEE Standard 241.
 - 2. Underwriters' Laboratories, Inc. (UL).
 - a. UL 20, 486A, 498, 508 and 943.
- B. Reference Standards:

1. National Electrical Manufacturers Association (NEMA):
 - a. NEMA Standards Publication / No. WD 1, WD 2, WD 5.
 2. National Electrical Contractors Association (NECA):
 - a. NECA – Standard of Installation.
- C. Material and equipment shall be new and conform to grade, quality and standards specified. Equipment or materials of the same type shall be the product of same manufacturer throughout.
- D. The manufacturer's catalog numbers specified represent the minimum standards required. If products of alternative manufacturers are selected from the approved manufacturer's list, they must be equal to or exceed the standards and performance criteria set forth.
- E. All supplied wiring devices shall be by a single manufacturer.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included here.
1. Cooper
 2. Hubbell Inc.
 3. Leviton.
 4. Pass and Seymour.

2.2 GENERAL

- A. Provide factory-fabricated wiring devices in type, color, and electrical rating for service indicated.
- B. See Symbol Schedule on drawings for identification of device type.

2.3 DEVICE COLORS

- A. Devices circuited from normal power panels shall be White in color.
- B. Devices circuited from emergency power panels shall be red in color.

2.4 GENERAL

- A. Terminal screws shall be back and side wired and accept #14, 12, and #10 AWG stranded or solid wire.
- B. A full wrap-around bridge strap shall be provided with locking tabs to secure receptacle face.
- C. Receptacle face shall be impact resistant nylon.

2.5 RECEPTACLES

- A. Heavy-Duty, Simplex:
1. Provide single heavy duty type receptacles, 2 pole, 3 wire, grounding, with green hexagonal equipment ground screw, 20 ampere, 125 volts, with NEMA configuration 5-20R unless otherwise indicated.
 - a. Cooper - 5361

- b. Pass & Seymour – 5361
 - c. Hubbell – HBL5361
 - d. Leviton - 5361
- B. Heavy-Duty Duplex:
 - 1. Provide heavy duty duplex receptacles, 2 pole, 3 wire, grounding, 20 ampere, 125 volts, with NEMA configuration 5-20R unless otherwise indicated.
 - a. Cooper 5352
 - b. Pass & Seymour – 5362
 - c. Hubbell – HBL5352
 - d. Leviton – 5362
 - 2. Tamper resistant safety type receptacles shall be:
 - a. Cooper – TR6350
- C. Ground-Fault Circuit Interrupters:
 - 1. Provide ground fault circuit interrupter, with heavy duty duplex receptacles, capable of being installed in a 2-1/2 inch deep outlet box without adapter. Shall be grounding type UL-rated Class A, Group 1, rated 20 amperes, 120 volts, 60 Hz; with solid-state ground fault sensing and signaling; with 5 milliamperes ground fault trip level. Equip with NEMA configuration 5-20 receptacle.
 - a. Test and reset buttons shall match color of face.
 - b. GFCI receptacles shall meet 2006 UL requirements.
 - c. If critical components within receptacle are damaged and the ground fault protection is lost, power to receptacle shall be automatically disconnected within the device.
 - 1) Pass & Seymour – 2094
 - 2) Hubbell – GFR5352
 - 3) Leviton – 8899
 - 2. GFCI type tamper resistant safety type receptacles shall be:
 - a. Cooper TRVGFxx (xx denotes Amperage size; either 15 or 20 to match breaker size)
- D. Duplex Convenience Isolated Ground Receptacles:
 - 1. Provide single heavy duty type receptacles, 2 pole, 3 wire, grounding, with green hexagonal equipment ground screw, 20 ampere, 125 volts, with NEMA configuration 5-20R unless otherwise indicated.
 - a. Device color shall match non isolated ground receptacles and have an orange triangle on the device.
 - 1) Cooper – IG5362
 - 2) Pass & Seymour – IG6300
 - 3) Hubbell – IG5362
 - 4) Leviton – 5362IG

2.6 SWITCHES

- A. General:
 - 1. Switches shall be rated for 20 amperes, 120/277 volts AC, and shall be manufacturer's specification grade toggle switch with thermoplastic abuse resistant toggle, quiet action, and heavy duty contact arm.
 - 2. Switches shall have quiet action mechanism with silver alloy contacts for longevity.
 - 3. Terminal screws shall be back and side wire and accept #14, 12, and 10 AWG stranded or solid wire.
 - 4. Switches shall have a backwire pressure plate ground screw mechanism accepting #14, 12, and 10 AWG stranded or solid wire.
- B. Single Pole:
 - 1. Cooper - 2221
 - 2. Pass & Seymour – PS20AC1

3. Hubbell – HBL1221
 4. Leviton – 1221-2
- C. Single Pole – Guestrooms:
1. Cooper CSB120
 2. Pass & Seymour – CSB20AC1
 3. Hubbell – CS1201
 4. Leviton – CSB1-15
- D. Double Pole Single Throw:
1. Cooper - 2222
 2. Pass & Seymour – PS20AC2
 3. Hubbell – HBL1222
 4. Leviton – 1222-2
- E. Three Way:
1. Cooper - 2223
 2. Pass & Seymour – PS20AC3
 3. Hubbell – HBL1223
 4. Leviton – 1223-2
- F. Four Way:
1. Cooper - 2224
 2. Pass & Seymour – PS20AC4
 3. Hubbell – HBL1224
 4. Leviton – 1224-2
- G. Key Switch – add suffix ‘KL’ to above part numbers.
- H. Momentary Contact:
1. Cooper - 1995
 2. Pass & Seymour – 1251
 3. Hubbell – HBL1557
 4. Leviton – 1257

2.7 DIMMERS – WALL BOX

- A. Incandescent Lamp:
1. Provide branch lighting solid-state AC dimmer controls for incandescent fixtures; wattage as indicated, 120 volts, 60 Hz single pole. Equip with electromagnetic filters to eliminate noise, RF and TV interference, and with 6 inch wire connecting leads. Do not remove fins.
 - a. Lutron (slide to off) type Nova NT series or equal for line voltage incandescent lamps.
 - b. Lutron (slide to off) Nova NTLV series or equal for low voltage incandescent lamps.
 - c. Provide wattage as indicated on drawings.
- B. Fluorescent Lamp:
1. Provide single pole, full-wave semi-conductor modular type AC dimmers for fluorescent fixtures; with 60 Hz, wattage and voltage as indicated, and with electromagnetic filters to reduce noise, RF and TV interference to minimum. Construct with continuously adjustable trim potentiometer for adjustment of low and dimming; and with anodized heat sinks. Provide 6 inch wire connecting leads.
 - a. Lutron type NTHF series or equal (slide to off).

2.8 WIRING DEVICE ACCESSORIES

- A. Wall Plates:

1. Provide wall plates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates; wall plates colored to match wiring devices. Provide plates possessing the following additional construction features:
 - a. Material and Finish:
 - 1) Stainless Steel (0.04 inch thick type 302 satin finished).
 - 2) Nylon, smooth – color to match device.
 2. Device plates for surface mounted Type FS or FD boxes: Type FSK galvanized steel covers.
 3. Device plates for surface mounted, 4 in. square boxes: ½ in. raised galvanized steel covers.
- B. Weatherproof Covers:
 1. Weatherproof covers for all 125-250 volt, 15 and 20 ampere receptacles installed outdoors in a wet location shall be weatherproof, NEMA 3R, with hinged outlet enclosure rated for rain proof protection while outlet is in use. The unit shall be furnished with a neoprene gasket between the mounting surface and the enclosure, and between the mounting plate and the hinged cover to assure proper seal.
 - a. Public Spaces
 - 1) Shall be equal to:
 - a) Tay Mac - ML400G.
 - (1) Available for use in building walls and standalone installations.
 - b) Intermatic – WP1000RC.
 - (1) Only use for flush mounting in building walls.
 - c) Pass & Seymour – WIUFC10S.
 - (1) Only available for flush mounting in non-CMU walls
 - b. Non-Public Spaces
 - 1) Shall be equal to:
 - a) Intermatic, Die Cast with GFI mounting plate, horizontal mount (duplex), Catalog #WP1010HMC, vertical mount (quad), Catalog #WP1030MC.
 2. Weatherproof covers for all other receptacles shall be cast aluminum with a gasketed cover. Shall be equal to Hubbell CWP26H (standard flush box) or Hubbell WPFS26 (surface FS box).
- C. Telephone / Power Poles:
 1. Provide factory assembled telephone / power poles of types, sizes and ratings indicated; for use with telephone and power systems installed above suspended ceilings. Construct with provisions for one telephone cable, cable size 50 pairs, and with two 15-ampere, 125-volt, 3-wire receptacles. Isolate power section from telephone compartment with separating steel enclosure. Extend wiring from receptacles to junction box at top of pole where connections are made above suspended ceiling. Provide pole foot with carpet pad; also provide pole with ceiling tile trim pad.

2.9 MULTIOUTLET ASSEMBLY

- A. Multi-outlet Assembly: Sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as multi-outlet assembly.
- B. Size: As indicated on Drawings.
- C. Receptacles: Furnish covers and accessories to accept receptacles specified in this section.

- D. Receptacle Spacing: 18 inches on center as indicated on drawings.
- E. Receptacle Color: White.
- F. Channel Finish: White.
- G. Fittings: Furnish manufacture's standard couplings, elbows, outlet and device boxes, and connectors.

2.10 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Watt Stopper: DT-300.
 - 2. Hubbell: Omni-DT-2000.
 - 3. Sensor Switch: CM-PDT-10.
 - 4. Substitutions permitted under provisions of Section 01630.
- B. Description: Dual technology sensor, using passive infrared and ultrasonic or micro-
phonic technology, ceiling mount occupancy sensor.
- C. Sensor shall have up to 2000 sq./ft. coverage.
- D. The ultrasonic frequency shall be minimum of 32 KHZ.
- E. Provide with temperature and humidity resistant receivers and a LED indicator.
- F. The sensor shall have an adjustable time-delay of 30 seconds to 15 minutes.
- G. Provide with power pack and/or slave pack as required.
- H. Adjusting: Contractor to adjust all sensors as follows:
 - 1. PIR and Ultrasonic detection required to turn "on" lights.
 - 2. No occupancy time delay at 10 minutes.
 - 3. PIR and Ultrasonic sensitivity to be set so that lights turn-on before occupant
proceeds more than 5 feet into room.
 - 4. Contractor to set and test all motion sensors 30 days prior to substantial
completion.
 - 5. Contractor to cooperate with commissioning agent to test and verify sensor
settings are as specified.

PART 3 EXECUTION

3.1 EXAMINATION

- A. See Division 1 - Administrative Requirements: Coordination and project conditions.
- B. Verify outlet boxes are installed at proper height.
- C. Verify wall openings are neatly cut and completely covered by wall plates.
- D. Verify branch circuit wiring installation is completed, tested, and ready for connection to
wiring devices.

3.2 PREPARATION

- A. Clean debris from outlet boxes.

3.3 EXISTING WORK

- A. Disconnect and remove abandoned wiring devices.
- B. Modify installation to maintain access to existing wiring devices to remain active.
- C. Clean and repair existing wiring devices to remain or to be reinstalled.

3.4 INSTALLATION

- A. Install devices plumb and level. Do not install devices until wiring is complete. Clean electrical boxes of dirt and debris.
- B. Install switches with OFF position down.
- C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Install receptacles with grounding pole on bottom.
- F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor. Isolated ground receptacles shall have the second ground wire (green with yellow tracer) ground the receptacle.
- G. Install decorative plates on switch, receptacle, and blank outlets in finished areas. Do not install until after painting is complete.
- H. Do not use terminals on wiring devices (hot or neutral) for feed thru connections, looped or otherwise. Make circuit connections via wire connectors and pigtails.
- I. Use jumbo size plates for outlets installed in masonry walls.
- J. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- K. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices.
- L. Mount switches and receptacles in vertical position in building interiors.
- M. All exterior receptacles shall be GFI type mounted in weatherproof boxes.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above back splash of counter.
- E. Install dimmer 48 inches above finished floor.

- F. Coordinate installation of wiring devices with under floor raceway service fittings provided under Section 26 05 39.
- G. Coordinate installation of wiring devices with floor box service fittings provided under Section 26 05 34.
- H. Mount receptacles with weatherproof plates in horizontal position.
- I. Install gasket plates for devices or system components having light emitting features, such as switch with pilot light and dome lights. Where installed on rough textured surfaces, seal with black self adhesive poly-foam.
- J. Provide hospital grade receptacles in all "Patient Care" areas as per N.E.C. Article 517 and Nevada Administrative Code.
- K. This Contractor shall check the switch location against the Architectural plans and shop drawings to be certain that switches are on the strike side of the door, regardless of swing shown on drawings. Edge of plate shall be not more than 12" from door frame.
- L. Install emergency switches which occur adjacent to normal light switches in separate boxes to maintain system's isolation in accordance with NEC required separation.
- M. Provide wiring device cover plates identifying device circuit numbers as outlined in specification 26 05 53.
- N. Ground-fault circuit interrupter type receptacles may provide GFI protection for downstream receptacles on same circuit only where located in same room as other receptacles.
- O. Provide hospital grade safety type, tamper resistant duplex receptacles in all pediatric locations.

3.6 FIELD QUALITY CONTROL

- A. See Division 1 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify each receptacle device is energized.
- E. Test each receptacle with Hubbell 5200, Woodhead 1750, or equal, for correct polarity, proper ground connection, and wiring faults.
- F. Test each GFCI receptacle device for proper operation.
- G. Provide a grounding system test in accordance with NFPA 99 for all receptacles in patient care areas.

3.7 ADJUSTING

- A. See Division 1 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust devices and wall plates to be flush and level.

3.8 CLEANING

- A. See Division 1 - Execution and Closeout Requirements: Final cleaning.
- B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

ENCLOSED TRANSFER SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes transfer switches in individual enclosures.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. Underwriters Laboratories Inc.:
 - 1. UL 1008 - Transfer Switch Equipment.
 - 2. UL 508 - Industrial Control Equipment.
- D. National Fire Protection Association:
 - 1. NFPA 70 - National Electric Code.
 - 2. NFPA 110 - Emergency and Standby Power Systems.
- E. Institute of Electrical and Electronic Engineers:
 - 1. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
- F. National Electrical Manufacturers Association:
 - 1. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches.

1.3 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Product Data: Submit catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.

1.4 CLOSEOUT SUBMITTALS

- A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed transfer switches.
- C. Operation and Maintenance Data: Submit routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

- B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

1.6 MAINTENANCE SERVICE

- A. See Division 1 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of transfer switches for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers:
 - 1. Match Generator manufacturer.

2.2 MECHANICALLY HELD TRANSFER SWITCHES

- A. The transfer switches shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
- B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
- C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
- D. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by a separate arcing contacts.
- E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
- F. Designs utilizing components of molded-case circuit breakers, contactors or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
- G. Where neutral conductors must be switched as shown on the plans, the ATS shall be provided with fully rated overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close in the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds. Neutral switching contacts which do not overlap are not acceptable.
- H. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

2.3

BYPASS-ISOLATION SWITCH

- A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.
- B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.
- C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.
- D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal", "Automatic", and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.
- E. The isolation handle shall provide three operating modes: "Closed", "Test" and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements with removal of power conductors or the use of any tools.
- F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.
- G. Designs requiring operation of key interlocks for bypass isolation or ATSS which cannot be completely withdrawn when isolated are not acceptable.

2.4

MICROPROCESSOR CONTROLLER

- A. The controller sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
- B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.2\%$. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.
- C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of operator manuals.

- D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
- E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - 1. IEEE472 (ANSI C37.90A) Ring Wave Test.
 - 2. ENC55011 1991 Class A Conducted and Radiated Emission.
 - 3. EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact & Air Discharge.
 - 4. EN61000-4-3 Radiated Electromagnetic Field Immunity.
 - 5. EN61000-4-4 Electrical Fast Transient Immunity.
 - 6. EN61000-4-5 Surge Immunity.
 - 7. ENV50141 HF Conducted Disturbances Immunity.

2.5 ENCLOSURE

- A. The automatic transfer and bypass-isolation transfer switches shall be furnished in a NEMA type 1 enclosure.
- B. All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.
- C. All transfer switches shall be front accessible only. Rear and side access shall not be required.

2.6 CONTROLLER DISPLAY AND KEYPAD

- A. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
 - 1. Nominal line voltage and frequency
 - 2. Single or three phase sensing
 - 3. Operating parameter protection
 - 4. Transfer operating mode configuration

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

2.7 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

- A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<u>Parameter</u>	<u>Sources</u>	<u>Dropout / Trip</u>	<u>Pickup / Reset</u>
Undervoltage	N&E,3f	70 to 98%	85 to 100%
Overvoltage	N&E,3f	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

- B. Repetitive accuracy of all settings shall be within $\pm$ 0.5% over an operating temperature range of -20°C to 60°C.

- C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- E. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

2.8 TIME DELAYS

- A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
- B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
- C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
- D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
- E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:
 - 1. Prior to transfer only.
 - 2. Prior to and after transfer.
 - 3. Normal to emergency only.
 - 4. Emergency to normal only.
 - 5. Normal to emergency and emergency to normal.
 - 6. All transfer conditions or only when both sources are available.
- F. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
- G. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

2.9 ADDITIONAL FEATURES

- A. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal. Test switch shall be key operated.
- B. A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

- C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.
- D. Elevator control interface auxiliary contacts. Transfer switches serving elevators shall be provided with auxiliary contacts designed to provide emergency system status to the elevator controllers. These contacts are in addition to the contacts required elsewhere in this specification. Required auxiliary contacts are as follows:
 - 1. Emergency Power signal contact. This shall be a form "C" contact that will change state and maintain its state as long as the transfer switch has transferred to the emergency power source.
 - 2. Pre-transfer warning signal contact. This contact shall be activated prior to the operation of the transfer switch, in either direction. These contacts shall change state prior to the transfer of power for a period of time as determined by the elevator installer, typically in the range of 10 to 20 seconds. These contacts shall reset to their normal state after the transfer has taken place. The pre-transfer warning signal shall not delay transfer for a time greater than allowed by the applicable codes.
- E. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
- F. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

The following features shall be inherent in the controller, and capable of being activated through keypad programming or the serial port only when required by the user:

- G. Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
- H. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
- I. A programmed transition feature shall be provided for the purpose of an intentional delay during load transfer. This function allows the voltage at the load terminals to decay prior to reconnecting the load to an energized source. This programmed transition shall include a generator set transfer time delay, which provides a minimum run time for the generator set once started, as well as, a time delay for retransfer to utility (normal) which gives the utility source time to stabilize.
- J. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
- K. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
 - 1. Enable or disable the routine.
 - 2. Enable or disable transfer of the load during routine.
 - 3. Set the start time,
 - time of day
 - day of week
 - week of month (1st, 2nd, 3rd, 4th, alternate or every)
 - 4. Set the duration of the run.

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

- L. System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example,
- Normal Failed
 - Load on Normal
 - TD Normal to Emerg
 - 2min15s
- Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator manual, are not permissible.
- M. Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
- N. Communications Interface - The controller shall be capable of interfacing, through an optional serial communication module, with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.
- O. Data Logging - The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
1. Event Logging
 - a. Data and time and reason for transfer normal to emergency.
 - b. Data and time and reason for transfer emergency to normal.
 - c. Data and time and reason for engine start.
 - d. Data and time engine stopped.
 - e. Data and time emergency source available.
 - f. Data and time emergency source not available.
 2. Statistical Data
 - a. Total number of transfers.
 - b. Total number of transfers due to source failure.
 - c. Total number of days controller is energized.
 - d. Total number of hours both normal and emergency sources are available.
- P. Communications Module - Provide a full duplex RS485 interface for the ATS controller to enable serial communications. The serial communications shall be capable of a direct connect or multi-drop configured network. The serial communication interface shall be equal to ASCO Accessory 72.
- Q. Load Shed Relay - all transfer switches except 'Critical' and 'Life Safety' branch transfer switches shall be provided with a load shed relay. Shall be energized from a 24 VDC signal from the generator to disconnect the load from the emergency source when an overload condition occurs.
- R. Elevator Presignal Contact - transfer switches serving elevators shall be provided with an elevator presignal contact to signal elevator controller that emergency source is available.

- S. Transfer switch serving x-ray loads shall have delayed transition when transferring from emergency to normal.
- T. Equipment Branch transfer switch shall have a selective load disconnect control circuit which operates before transfer between two live sources. One form C contact rated 3 amps 480 VAC to operate an adjustable 1 second to 10 minutes before transfer, factory set at 3 minutes, and resetting after transfer.
- U. Provide three phase ammeter with selector switch (with current transformer and shorting blocks).
- V. Provide analog AC meter display panel to display 3-phase AC Amps, 3-Phase AC volts, Hz, KW load level and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.

2.10 WITHSTAND AND CLOSING RATINGS

- A. The ATS/BPS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS/BPS terminals with the type of overcurrent protection shown on the plans. Withstand rating shall be 42 KA at 480 volts unless otherwise indicated on drawings.
- B. The ATS/BPS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 12 and 3 cycle long-time ratings. ATS/BPS's which are not tested and labeled with 12 and 3 cycle (any breaker) ratings and have series or specific breaker ratings only, are not acceptable.

2.11 SOURCE QUALITY CONTROL

- A. Furnish shop inspection and testing of each transfer switch.
- B. Make completed transfer switch available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least seven days before inspection is allowed.
- C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner at least seven days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned transfer switches.
- B. Clean and repair existing transfer switches to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install housekeeping pads in accordance with Section 03 30 00.
- B. Install engraved plastic nameplates in accordance with Section 26 05 53.
- C. Provide control wiring between all transfer switches and associated generator controller. Provide control wiring between transfer switches serving elevators and elevator controllers. Control wiring shall be No. 12 minimum.

3.3 FIELD QUALITY CONTROL

- A. See Division 1 - Quality Requirements Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.22.3.

3.4 MANUFACTURER'S FIELD SERVICES

- A. See Division 1 - Quality Requirements: Manufacturers' field services.
- B. Check out transfer switch connections and operations and place in service.
- C. Retain services of transfer switch manufacturer's factory trained technician to perform following services.
 - 1. After engine/generator load bank test and after engine/generator set is electrically connected to automatic transfer switches, provide comprehensive demonstration of system maintenance and operation to Owner or Owner's maintenance personnel.
 - 2. Include minimum of six simulated power failures.
- D. Verify operation of remotely connected control wiring and interlocks.

3.5 ADJUSTING

- A. See Division 1 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust control and sensing devices to achieve specified sequence of operation.

3.6 DEMONSTRATION AND TRAINING

- A. Demonstrate operation of transfer switch in [bypass,] normal, and emergency modes.

END OF SECTION

SECTION 26 29 16

ENCLOSED CONTACTORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes enclosed contactors for lighting and general purposes.
- B. Related Sections:
 - 1. Section 26 28 13 - Fuses.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
 - 5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. Underwriters Laboratories Inc:
 - 1. UL 489 - Molded Case Circuit Breakers and Molded Case Switches and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

- A. See Division 1 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit dimensions, size, voltage ratings and current ratings.

1.4 CLOSEOUT SUBMITTALS

- A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations and ratings of enclosed contactors.
- C. Operation and Maintenance Data: Submit instructions for replacing and maintaining coil and contacts.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

- A. Manufacturers:

1. Square D.
 2. General Electric.
 3. Cutler Hammer.
 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA ICS 2, AC general purpose magnetic contactor.
- C. Coil operating voltage: 120 volts, 60 Hertz.
- D. Poles: To match circuit configuration and control function.
- E. Product Features:
1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
 2. Pushbutton: ON/OFF function, with shrouded configuration.
 3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
 4. Indicating Light: RED lens, transformer type, with neon lamp.
 5. Auxiliary Contacts: One field convertible in addition to seal-in contact.
 6. Relays: NEMA ICS 2.
 7. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- F. Combination Contactors: Combine contactors with thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.
- G. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R.

2.2 LIGHTING CONTACTORS

- A. Manufacturers:
1. General Electric.
 2. Square D
 3. Cutler Hammer.
 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA ICS 2, magnetic lighting contactor.
- C. Configuration: Electrically held.
- D. Coil operating voltage: 120 volts, 60 Hertz.
- E. Poles: To match circuit configuration and control function.
- F. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.
- G. Accessories:
1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
 2. Pushbutton: ON/OFF function, with shrouded configuration.
 3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
 4. Indicating Light: RED lens, transformer type, with led lamp.
 5. Auxiliary Contacts: One field convertible in addition to seal-in contact.

- 6. Relays: NEMA ICS 2.
 - 7. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- H. Combination Contactors: Combine contactors with thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect abandoned enclosed contactors and remove abandoned enclosed contactors.
- B. Maintain access to existing enclosed contactors and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing enclosed contactors to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install enclosed contactors in accordance with NECA "Standard of Installation."
- B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 05 29.
- C. Height: 5 ft (1500 mm) to operating handle.
- D. Install fuses for fusible switches. Refer to Section 26 28 13 for product requirements.
- E. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.

3.3 FIELD QUALITY CONTROL

- A. See Division 1 - Quality Requirements Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION

ENGINE GENERATORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes engine generator set, exhaust silencer and fittings, fuel fittings , remote control panel, Load bank, battery, and charger.
- B. Related Sections:
 - 1. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
 - 2. Section 23 07 00 - HVAC Insulation.
 - 3. Section 23 11 13 - Facility Fuel-Oil Piping: Product and execution requirements for fuel oil piping within 5 feet (1500 mm) of building.
 - 4. Section 23 11 23 - Facility Natural-Gas Piping: Product and execution requirements for gas piping within 5 feet (1500 mm) of building.
 - 5. Section 23 12 13 - Facility Fuel-Oil Pumps: Product and execution requirements for fuel oil pumps.
 - 6. Section 23 13 00 - Facility Fuel-Storage Tanks: Product and execution requirements for fuel oil tanks.
 - 7. Section 23 21 23 - Hydronic Pumps.
 - 8. Section 23 24 16 - Internal-Combustion Engine Exhaust Piping.
 - 9. Section 23 31 00 - HVAC Ducts and Casings.
 - 10. Section 23 57 00 - Heat Exchangers for HVAC: Execution requirements for [remote radiator] [heat exchanger] specified by this section.
 - 11. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 12. Section 26 05 53 - Identification for Electrical Systems.
 - 13. Section 26 28 26 - Enclosed Transfer Switches.
 - 14. Section 33 51 00 - Natural-Gas Distribution: Product and execution requirements for site natural gas distribution systems.
 - 15. Section 33 52 13 - Fuel-Oil Distribution: Product and execution requirements for factory insulated piping for use with oil distribution systems in below ground applications.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
 - 3. NEMA MG 1 - Motors and Generators.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 30 - Flammable and Combustible Liquids Code.
 - 2. NFPA 99 - Standard for Health Care Facilities.
 - 3. NFPA 110 - Standard for Emergency and Standby Power Systems.
- D. Underwriters Laboratories Inc:
 - 1. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breakers Enclosures.

1.3 SYSTEM DESCRIPTION

- A. Description: Engine generator assembly and accessories to provide source of power for Level 1 and 2 applications in accordance with NFPA 110.
- B. Capacity: 80 kW, 100 kVA at elevation of 3,300 feet above sea level, continuous standby rating using specified engine cooling scheme.

1.4 SUBMITTALS

- A. See Division 1 - Submittal Procedures: Submittal procedures.
- B. Engine-generator submittals shall include the following information:
 - 1. Factory published specification sheet indicating standard and optional accessories, ratings, ECT.
 - 2. Manufacturer's catalog cut sheets of all auxiliary components such as isolators, battery charger, silencer, exhaust flex, main circuit breaker, ECT.
 - 3. Dimensional elevation and layout drawings of the generator set, enclosure and switchgear and related accessories.
 - 4. Weights of all equipment.
 - 5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
 - 6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, fuel tank, battery charger, jacket water heater, space heater and remote alarm indications.
 - 7. Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, ECT.
 - 8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
 - 9. Generator resistances, reactances and time constants.
 - 10. Generator current decrement curve.
 - 11. Generator motor starting capability.
 - 12. Generator thermal damage curve.
 - 13. Jacket water heater connection diagram.
 - 14. Control panel schematics.
 - 15. Automatic load transfer switch(es).
 - 16. Oil sampling analysis, laboratory location, and information.
 - 17. Manufacturer's and dealer's written warranty.
 - 18. Emissions data.

1.5 FACTORY PROTOTYPE TESTING

- A. The system manufacturer must certify that engine, generator, and controls have been tested as a complete system of representative engineering models (not on equipment sold).
- B. Prototype testing shall include:
 - 1. Fuel consumption at $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and full load.
 - 2. Exhaust emissions.
 - 3. Mechanical and exhaust noise.
 - 4. Governor speed regulation at $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and full load; and during transients.
 - 5. Motor starting kVA.
 - 6. Generator temperature rise in accordance with NEMA MG1-22.40.
 - 7. Voltage regulation at $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and full load; and during transients.
 - 8. Harmonic analysis, voltage waveform deviation and telephone influence factor.
 - 9. Generator short circuit capability.
 - 10. Cooling system performance.
 - 11. Torsional analysis.
 - 12. Linear vibration analysis.

13. Generator revolving field assembly for 2 hours at 2700 rpm (150% overspeed) and 70°C, and each production unit tested at 2250 rpm (125% overspeed) at room temperature.
14. The manufacturer shall supply equipment that is a current factory production model, not a one-time fabrication.

1.6 SUPPLIER'S OR MANUFACTURER'S SERVICES

- A. Retain services of engine/generator set manufacturer's factory trained technician employed by engine/generator set manufacturer or his authorized distributor to perform the following services:
- B. Installation Services:
 1. Visit project site to review installation requirements with Contractors involved prior to permanently installing equipment and/or making mechanical or electrical connections. Contractor to coordinate meeting to ensure presence of all parties concerned.
 2. Provide a 3 phase portable load bank at project site, in addition to normal factory tests, after equipment has been permanently installed. Follow manufacturer's procedures. Submit release signed by supplier and Contractor to Owner and Engineer with deficiencies notes, if any, along with proposed solutions.
- C. Instructional Services:
 1. Provide a comprehensive demonstration to Owner, maintenance personnel, or their designated agents of system maintenance and operation after load bank test and after engine/generator set is electrically connected to automatic transfer switches.
 - a. Include a minimum of three simulated power failures in the presence of transfer switch manufacturer's startup representative.
 - b. Test remotely connected engine/generator status indication signals.
 - c. Test transfer switches.
 - d. Contractor to coordinate meeting to ensure presence of all parties concerned.

1.7 PARTS AND SERVICE QUALIFICATIONS

- A. The engine-generator supplier shall have service facilities within 45 miles of the project site and maintain 24-hour parts and service capability. The dealer shall stock parts as needed to support the generator set package for this specific project.
- B. The dealer shall maintain qualified, factory trained service personnel that can respond to an emergency call within 4 hours of notification.

1.8 CLOSEOUT SUBMITTALS

- A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions and service manuals for normal operation, routine maintenance, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.9 WARRANTY

- A. See Division 1 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty.

1.10 MAINTENANCE SERVICE

- A. See Division 1 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of engine generator for one year from Date of Substantial Completion.

1. Include all supplies required for normal maintenance service.

1.11 MAINTENANCE MATERIALS

- A. See Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of tools required for preventative maintenance of engine generator system. Package tools in adequately sized metal tool box.
- C. Furnish two of each fuel, oil and air filter element at end of warranty maintenance period.

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

- A. Temperature: 110 degrees F.
- B. Altitude: 3,300 feet.

2.2 ENGINE

- A. MANUFACTURERS:
 1. Caterpillar.
 2. Cummins.
 3. Kohler.
 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. ENGINE CONSTRUCTION
 1. Watercooled with plant mounted radiator.
 2. In-line or vee-type four-cycle compression ignition diesel.
 3. Naturally aspirated or turbo-charged.
 4. Heavy duty industrial.
 5. Using Natural Gas.
 6. 24 VDC positive engagement, solenoid shift, starting motor.
 7. 1800 rpm.
- C. ENGINE ACCESSORY EQUIPMENT
 1. Engine shall have standard and optional accessory equipment packages including but not limited to the following equipment:
 - a. Precision Electronic governor, steady state regulation +/- .25%. Woodward or equal.
 - b. Lubrication break-in oil.
 - c. Electric fuel solenoid shut-off valve with standard fuel filter on engine.
 - d. Heavy-duty air cleaner.
 - e. Oil drain extension through side of skid base.
 - f. Lube oil filter with replaceable elements.
 - g. Overspeed cut-out.
 - h. Low pressure cut-out.
 - i. Flexible fuel connections.
 - j. Seamless, flanged stainless steel, flexible exhaust connection.
 - k. Engine coolant heater, 208_volt, single phase with adjustable thermostat, thermal circulation type size to maintain engine jacket water at 90 degrees F.
 - l. Welded steel skid type base securely mounted with anchored mounting bolts and with heavy-duty vibration isolators. Isolators shall be spring type or rubber linear type, bolted to generator frame.
- D. STARTING BATTERIES AND CHARGER
 1. Starting Batteries:

- a. 24 VDC.
- b. Lead acid type sized for 60 seconds total cranking time at 32 degrees F.
- c. Stranded copper battery cables.
- d. Free standing metal rack with acid-resistant paint.
- 2. Automatic Battery Charger:
 - a. Transistor controlled magnetic amplifier circuit to provide continuous taper charging.
 - b. Maintain constant voltage output with AC line fluctuations of +/- 10%.
 - c. Two ranges, float at 2.17 VPC and equalize at 2.33 VPC.
 - d. Automatic AC line compensation.
 - e. Automatic overload protection current limiting.
 - f. Silicone diode full-wave rectifiers.
 - g. Automatic surge suppressors.
 - h. DC ammeter and voltmeter.
 - i. Fused AC input and DC output.
 - j. 10 amp DC output minimum, size to carry DC continuous load current and simultaneously recharge the battery within 4 hours. Lamarche A-46 or approved equal.
 - k. NEMA 1 enclosure for wall mounting.
 - l. U.L. Label.
 - m. Alarm contacts – low voltage and charger failure.
- 3. Battery Heater:
 - a. Provide battery heater with thermostat as required by NFPA 110.

E. EXHAUST EQUIPMENT

- 1. Exhaust silencer:
 - a. Critical type.
 - b. Companion flanges and gaskets.
 - c. Aluminized steel.
- 2. Piping:
 - a. Black steel with condensate drip pocket and drain valve.
 - b. Exhaust pipe shall turn upward and be provided with waterproof cap.

F. COOLING EQUIPMENT

- 1. Unit Mounted Radiator:
 - a. Pusher type fan.
 - b. Low water level contact in radiator with low level engine shutdown.
 - c. Sized for 50% ethylene-glycol solution at 110 degrees F. ambient and 3300 ft. elevation.
 - d. Ethylene-glycol antifreeze with rust inhibitor –50% solution.
 - e. Radiator air flow restriction 0.5 inches of water maximum.

2.3 GENERATOR CONSTRUCTION

- A. 3 ph. 60Hz.
- B. Vacuum epoxy encapsulated insulation, NEMA Class H.
- C. Temperature rise not to exceed 130 degrees C, above an ambient temperature of 40 degrees C.
- D. Unit to sustain 300% rated output for 10 seconds to allow downstream selective circuit breaker tripping in the event of a fault. Either series boost or PMG acceptable. Generator supplier to install all series boost components. So called “extended stacks” will not be acceptable.
- E. Single bearing.
- F. Synchronous type.
- G. TIF less than 50 volts per hertz regulation.

- H. Radio suppression.
- I. Build to NEMA, IEEE, and ANSI standards.
- J. Brushless, direct-connected type exciter with shaft mounted diodes and built-in permanent magnets to eliminate field flashing.
- K. SCR type automatic digital voltage regulator to provide +/- 1/2% voltage regulation from no load to full load.
- L. Application of one-step load of 100% of rated load shall not result in voltage dip of more than 30% with recovery to within +/- 1/2 of 1% in less than 7 sec.
- M. Unit must accept a block load of 100% nameplate rating.
- N. Regulator shall have 3-phase sensing.
- O. Anti-condensation space heater – 120 volt.

2.4 GOVERNOR

- A. Manufacturers:
 - 1. Woodward.
 - 2. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Isochronous governor to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.

2.5 ENGINE/GENERATOR CONTROLLER

- A. NEMA Type 12 enclosure, vibration isolated on generator enclosure.
- B. Plug-in solid state design circuitry for quick modular replacement.
- C. Fused DC circuits.
- D. Complete 2 wire start/stop control to operate on activation of remote contact from automatic transfer switches.
- E. Design starting system for restarting in event of false engine start by permitting engine to completely stop and then re-engage starter. Provide cyclic cranking.
- F. Overcranking protection designed to open cranking circuit after three (3) start attempts.
- G. Circuitry to shut down engine when signals for high coolant temperature, low oil pressure, overcrank or overspeed are received, with reset button.
- H. Adjustable 2 to 15 min. factory set at 5 min. time delay to permit unloaded running of standby set after transfer of load to normal.
- I. Four position automatic/off/reset/test selector switch.
- J. Emergency stop switch.
- K. Indicating Lights with alarm horn to signal:

System Ready	- Green
Selector Switch OFF	- Red – Flashing

Overcrank	- Red
High coolant temperature	- Red
Overspeed	- Red
Low oil pressure	- Red
Low Fuel	- Red
Low water coolant level	- Red

- L. Battery Charger Malfunction with “high and low” battery voltage indicator.
- M. Test button for indicating lights.
- N. Voltmeter, digital, .5% true RMS accuracy with selector switch.
- O. Ammeter, digital, .5% true RMS accuracy with CT's and selector switch. Voltmeter-ammeter phase selector switch.
- P. Direct reading type frequency meter, digital 1% accuracy.
- Q. Panel illumination lights.
- R. Battery charging ammeter.
- S. Oil Pressure gauge.
- T. Running time meter.
- U. Pre-alarm features per NFPA 110, Level 1.
- V. Plug-in voltage regulator with voltage adjusting rheostat.
- W. Unpowered normally open auxiliary interlock contacts wired to terminal block:
 - 1. Generator failure signal to remote location.
 - 2. Generator run signal to remote location.
- X. Line circuit breaker, molded case, solid-state, 250 amp, 3 pole, 600 V, 100% rated in NEMA 1 enclosure, unit mounted, factory wired. **Breaker shall be provided with ground fault protection (ground fault indication).** Locate breaker within the generator terminal box.

2.6 WEATHERPROOF ENCLOSURE

- A. The engine/generator set, including battery charger and batteries shall be completely enclosed in a weatherproof outdoor shelter provided by the manufacturer.
- B. Size shall be as required to house generator and accessories. The set shall be constructed of welded and bolted 14 and 16 gauge reinforced steel sheet.
- C. Housing shall have shuttered air openings on the front and sides, with mesh screens covering side shutters. Hinged doors shall provide access on each side and on the rear. Door handles shall be Key-lock type or padlock type. A removable panel shall provide access below the engine oil pan.
- D. Metal parts shall be prime and finish painted at the factory for corrosion resistance in an outdoor environment. Color of generator enclosure shall be “special” color as selected by Architect.
- E. Enclosure shall be mounted to the base of the engine generator set. Slip-over enclosures are not acceptable.

2.7 CUSTOMER INTERFACE MODULE

- A. Provide Customer Interface Module Caterpillar #CIM which shall provide dry contacts for all alarms and prealarms for remote annunciator purposes.

2.8 REMOTE ALARM ANNUNCIATOR

- A. Remote mounted annunciator panel (locate in _____) shall be provided to give visual and audible indication of impending alarm conditions, engine failure conditions and monitor certain operational functions. It shall conform with the requirements of NFPA 110, Level 1 and NFPA 99. Shall be wall mounted. Refer to attached Safeties Checklist for required remote visual alarm conditions required to be monitored.

2.9 REMOTE EMERGENCY STOP SWITCH

- A. Provide remote emergency stop switch with protective cover. Switch shall shut down engine generator. Install at location as indicated on drawings.

2.10 LOAD BANK

- A. Load Bank: Complete load bank for pacing resistive load on generator. 208 volts 3 phase 40 KW 50 KVA. Complete with transfer switches, disconnect, ventilation fans and enclosure.

2.11 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assembly.
- B. Make completed engine-generator assembly available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least seven days before inspection is allowed.
- C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner at least seven days before inspections and tests are scheduled.
- D. The complete generator set package shall be fully tested at the factory before shipment to the project site. A certified test report shall be furnished which shows that the unit will provide full nameplate rating at 0.8 power factor.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned engine-generator assemblies and accessories.
- B. Clean and repair existing engine-generator assemblies to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install engraved plastic nameplates in accordance with Section 26 05 53.
- B. Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes.
 - 1. Lubrication and break-in oil to be supplied and installed by supplier's or manufacturer's technician at time of startup.
 - 2. Antifreeze with rust inhibitor, (50% solution) to be supplied and installed by supplier's or manufacturer's technician at time of startup.
- C. Starting Batteries and Charger:

1. Locate freestanding battery rack near engine starter and connect cables with suitable lugs.
 2. Mount battery charger near batteries and extend battery charging wires to batteries.
- D. Remote Alarm Annunciators:
1. Provide wiring installed in conduit between generator and remote alarm annunciators per manufacturer's recommendations. Wiring shall be installed in conduit.
- E. Remote Manual Stop:
1. Provide wiring installed in conduit between generator and remote manual stop to shut down generator and shut off fuel supply to generator.
- F. Ground and bond generator and other electrical system components in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. See Division 1 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.22.
- D. Field Tests Prior to Startup:
1. Megger check of phase-to-phase and phase-to-ground insulation levels.
 2. Continuity.
 3. Short circuit.
 4. Do not megger check solid state equipment.
- E. Perform additional tests according to engine/generator manufacturer's instructions.

3.4 MANUFACTURER'S FIELD SERVICES

- A. See Division 1 - Quality Requirements: Manufacturer's field services.
- B. Coordinate all start-up and testing activities with the Engineer and Owner.
- C. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:
1. Verify that the equipment is installed properly.
 2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, ECT.
 3. Test all alarms and safety shutdown devices for proper operation and annunciation.
 4. Check all fluid levels.
 5. Start engine and check for exhaust, oil, fuel leaks, vibrations, ECT.
 6. Verify proper voltage and phase rotation at the switchgear before connecting to the load.
 7. Connect the generator to building load and verify that the generator will start and run all designated loads in the plant.

3.5 ADJUSTING

- A. See Division 1 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust generator output voltage and engine speed to meet specified ratings.

3.6 CLEANING

- A. See Division 1 - Execution and Closeout Requirements: Final cleaning.
- B. Clean engine and generator surfaces. Replace oil and fuel filters with new.
- C. Touch up scratches or marred surfaces to match original finish.

3.7 SUPPLIER'S OR MANUFACTURER'S SERVICES

- A. Retain services of engine/generator set manufacturer's factory trained technician employed by engine/generator set manufacturer or his authorized distributor to perform following services:
 - 1. Installation Services:
 - a. Visit project site to:
 - 1) Review installation requirements with CONTRACTORS involved. Prior to permanently installing equipment and/or making mechanical or electrical connections.
 - 2) CONTRACTOR to coordinate meeting to ensure presence of parties concerned.
 - b. Provide a 3-phase portable load bank at project site, in addition to prototype and factory tests.
After equipment has been permanently installed:
 - 1) Connect engine/generator set to the load bank and conduct a 4-hour test.
 - 2) Vary Load on generator from 5% to 100% to determine that voltage, frequency, capacity, fuel, combustion air, cooling, and ventilation systems are adequate.
50% load for 60 minutes.
75% load for 60 minutes.
100% load for 2 hours.
 - 3) Apply each increment of load in one step.
Maximum voltage dip of 30%
Recovery of less than 7 seconds to maintain voltage and frequency as specified.
 - 4) Submit release signed by supplier and CONTRACTOR to OWNER and ENGINEER with deficiencies noted, if any, along with proposed solutions.
 - 5) Block load unit from no load to 100% load in one step.
 - 2. Instructional Services:
 - a. Provide a comprehensive demonstration to OWNER or maintenance personnel of system maintenance and operation after load bank test and after engine/generator set is electrically connected to automatic transfer switch.
 - 1) Include a minimum of six simulated power failures in the presence of transfer switch manufacturer's startup representative.
 - 2) Test remotely connected engine/generator status indication signals.
 - 3) Test transfer switches.
 - 4) CONTRACTOR to coordinate meeting to ensure presence of all parties concerned.

3.8 WARRANTY

- A. Equipment furnished under these specifications and Section 26 28 26 shall be guaranteed against defective parts and workmanship under terms of the manufacturer's and dealer's standard warranty. But, in no event, shall it be for a period of less than two years from the date of initial startup of the system and shall include labor and travel time for necessary repairs at the job site. Running hours shall not be a limiting factor for the system warranty.

3.9 SCHEDULED OIL SAMPLING

- A. In order to forecast and minimize engine downtime, the supplier of the equipment must provide an oil sampling analysis kit which operating personnel shall utilize for Scheduled Oil Sampling.
- B. The laboratory to which oil samples will be sent shall not be located at and a part of the local generator set supplier's facility. Independent laboratories not a part of the engine supplier's facility are allowed as to conformance with this specification.
- C. Scheduled Oil Sampling shall be of the atomic absorption spectrophotometry method and shall be accurate to within a fraction of one part per million for the following elements:
 - 1. Iron
 - 2. Chromium
 - 3. Copper
 - 4. Aluminum
 - 5. Silicon
 - 6. Lead
- D. In addition, the sample shall be tested for the presence of water, fuel dilution, and antifreeze.
- E. All equipment needed to take oil samples shall be provided in a kit at the time of acceptance and shall include the following:
 - 1. Sample extraction gun (1).
 - 2. Bottles (10).
 - 3. Postage-paid mailers (10).
 - 4. Written instructions (1).
- F. Immediate notification shall be provided to the Owner when analysis shows any critical reading. If readings are normal, a report showing that the equipment is operating within established parameters shall be provided.
- G. This Scheduled Oil Sampling kit shall be made available, at additional cost, to the Owner beyond the mandatory starter kit specified previously and shall be optional for the Owner to continue this service after the starter kit has been depleted.

3.10 SYSTEM SERVICE CONTRACT

- A. In order to meet potential insurance company regulations and provide longest reliable service life, the supplier of the standby power system shall provide and make available to the Owner a service contract which, at the Owner's option, may be accepted or refused. The contract shall be for the complete services rendered over a period of one year and shall include, but not be limited to, the following:
- B. Engine manufacturer's recommended procedures for weekly (biweekly) inspection and maintenance to be done by user.
- C. Quarterly inspection by the supplier personnel to review the weekly (biweekly) maintenance records being kept by user and train any new Owner operating personnel. Inspection will include scheduled oil sampling for lube oil contaminants. A 100% load test run on the generator set shall also be included.
- D. Annual inspection shall include all of the items in above paragraph except that the generator set shall be run under load – system load or load provided by supplier.

SAFETIES CHECKLIST

Function	CV	S	CA	RV	RA	VERIFIED
(A) OVERCRANK	X	X	X	X	X	
(B) LOW WATER TEMP. <70° F (21 C)	X		X	X	X	
(C) HIGH ENGINE TEMPERATURE PREALARM	X		X		X	
(D) HIGH ENGINE TEMPERATURE	X	X	X	X	X	
(E) LOW LUBE OIL PRESSURE PREALARM	X		X		X	
(F) LOW LUBE OIL PRESSURE	X	X	X	X	X	
(G) OVERSPEED	X	X	X	X	X	
(H) LOW FUEL MAIN TANK (48 HR)				X	X	
(I) LOW COOLANT LEVEL	X		X		X	
(J) EPS SUPPLYING LOAD	X			X		
(K) CONTROL SWITCH NOT IN AUTO. POSITION	X		X		X	
(L) BATTERY CHARGER MALFUNCTIONING	X		X	X		
(M) HIGH BATTERY VOLTAGE	X		X			
(N) LOW VOLTAGE IN BATTERY	X		X			
(O) LAMP TEST	X			X		
(P) CONTACTS FOR LOCAL AND REMOTE COMMON ALARM						
(Q) AUDIBLE ALARM SILENCING SWITCH			X		X	
(R) LOW STARTING AIR PRESSURE (1)	X		X	O		
(S) LOW STARTING HYDRAULIC PRESSURE (1)	X		X	O		
(T) AIR SHUTDOWN DAMPER WHEN USED	X	X	X	O	X	
(U) REMOTE EMERGENCY STOP		X				
(V) LOW FUEL DAY TANK				X	X	
(W) HIGH FUEL LEVEL DAY TANK				X	X	
(X) GROUND FAULT WHEN PROVIDED				X	X	
(Y) CRANK CYCLE TEST 15 SEC. ON 15 OFF						
(Z) CONTINUOUS CRANK MAX. 45 SEC. (2)						
(AA) CYCLE CRANKING LIM (SEC) 75 MAX.						
(BB) FLOAT TYPE BATT. CHGR W/DC AMMETER & VOLTMETER						
(CC) BATTERY RECHARGE TIME - 24 HOURS						

(DD) BLOCK HEATER DISCONNECT ON START					
WATER TEMPERATURE MIN 90° F (OUTSIDE (EE) UNITS)					
(FF) BATTERY HEATERS MAINTAIN 50° - 90° F (3)					
(GG) GENERATOR ROOM TAMP. MIN. 70° F					

Key:

CV Control panel mounted visual indication.
CA Control panel – mounted audible.
RV Remote visual.
RA Remote audible.
S Shutdown of EPS.
X Required.
O Can be a common audible and visual signal.

Notes:

- (1) Only applies when applicable as a starting method.
- (2) All diesel engines shall be permitted to use continuous cranking methods.
- (3) Not required if enclosure temperature maintained at not less than 32°F.

GENERATOR COLD START LOAD TEST

DATE:	TIME:			REMARKS:						
TIME DELAY ON START										
CRANK TIME TO START										
TIME TO OPER. SPEED										
VOLTAGE OVERSHOOT										
FREQUENCY OVERSHOOT										
TIME TO STEADY STATE WITH ALL ATS=S TRANSFERRED										
AMBIENT TEMP.										
START TIME	0 MIN.	5 MIN.	10 MIN.	15 MIN.	30 MIN.	45 MIN.	60 MIN.	75 MIN.	90 MIN.	120 MIN.
VOLTS PHASE A										

VOLTS PHASE B										
VOLTS PHASE C										
FREQUENCY A										
FREQUENCY B										
FREQUENCY C										
AMPERES A										
AMPERES B										
AMPERES C										
OIL PRESSURE										
WATER TEMP										
BATTERY CHRG										
RATE										
STOP TIME:										

GENERATOR FULL LOAD TEST

DATE:	TIME:			REMARKS:						
CRANK TIME TO START										
TIME TO OPER. SPEED										
VOLTAGE OVERSHOOT										
FREQUENCY OVERSHOOT										
TIME TO STEADY STATE WITH ALL ATS=S TRANSFERRED										
AMBIENT TEMP.										
START TIME	0 MIN.	5 MIN.	10 MIN.	15 MIN.	30 MIN.	45 MIN.	60 MIN.	75 MIN.	90 MIN.	120 MIN.
VOLTS PHASE A										
VOLTS PHASE B										
VOLTS PHASE C										
FREQUENCY A										
FREQUENCY B										
FREQUENCY C										

AMPERES A										
AMPERES B										
AMPERES C										
OIL PRESSURE										
WATER TEMP										
BATTERY CHRG RATE										
STOP TIME:										
INSTANTANEOUS VOLT DIP ON ONE STEP	INSTANTANEOUS VOLT DIP ON ONE STEP				FREQUENCY DROOP (ONE STEP LOAD)			FREQUENCY DROOP (ONE STEP LOAD)		
FACTORY =	FIELD =				FACTORY =			FIELD =		

TRANSFER SWITCH DATA

ATS BRANCH	BRANCH NAME	TYPE AUTO/MAN	SIZE AMPS	NO. POLES	AIC & VOLTS	TIME TO EMERG. IN SEC-S	RE- TRANSFER TO NORM TIME IN MIN.

END OF SECTION

SECTION 26 51 50

INTERIOR LIGHTING – SOLID STATE LIGHTING (SSL)

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. LED lamps
- B. LED Dimming Drivers
- C. Integral lighting controls

1.2. RELATED DOCUMENTS

- A. Section 26 0943 – Network Lighting Controls
- B. Section 26 2726 – Wiring Devices
- C. Section 26 0923 – Lighting Control Devices

1.3. REFERENCE STANDARDS

- A. National Energy Policy Act of 2005, Public Law No. 109-58.
- B. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.
- D. IESNA LM-79-08 IESNA - Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- E. IESNA LM-80-08 IESNA - Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- F. IESNA TM-21-2011 – Projecting Long Term Lumen Maintenance of LED Light Sources.
- G. UL 1310 and 8750 – Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- H. OSHA 29CFR1910.7 – luminaires shall be listed by nationally recognized testing laboratory approved by United States Department of Labor, Occupational Safety and Health Administration (OSHA).
- I. ANSI C82.11 – Performance requirement for high frequency ballasts.
- J. ANSI/IES RP-16-10 – Nomenclature and definitions for illuminating engineering.
- K. ANSI C62.41 – Recommended practice in low power circuits.
- L. IEC 61347-1 – General and safety requirements for lamp control gear.
- M. IEC 61347-2-13 – Particular requirements for electronic control gear for LED modules.
- N. IEC 62384 - DC or AC supplied electronic control gear for LED modules – performance requirements.

- O. IEC 61000-3-2 - Harmonic current emissions.
- P. IEC 61547 - EMC immunity requirements.
- Q. IEC 62386-101/102/207 – Digital addressable lighting interface (DALI).
- R. Federal Communications Commission (FCC) rules – Part 15 Class B: Radio Frequency Devices.
 - 1. Commercial rated
- S. Entertainment Services and Technology Association
 - 1. ESTA E1.3 - Entertainment Technology - Lighting Control System - 0 to 10V Analog Control Protocol.

1.2 DEFINITIONS

CALiPER	DOE Commercially Available LED Product Evaluation and Reporting program for the testing and monitoring of commercially available LED Luminaires and lights. http://www1.eere.energy.gov/buildings/ssl/m/caliper.html
CCT	Correlated Color Temperature: The temperature in units of kelvin of a blackbody whose chromaticity most nearly resembles that of the light source in question.
cd	Candela: SI Unit of luminous intensity, equal to 1 lumen per steradian (lm/sr).
Chromaticity	The property of color of light defined by the dominant or complementary wavelength and purity aspects of the color taken together.
CRI	Color Rendering Index – measure of the degree of color shift of reference objects when illuminated by the light source as compared to a reference source of comparable color temperature.
fc	Footcandle: Unit of illuminance, equal to 1 lm/ft ² .
L80	The extrapolated life in hours of the luminaire when the luminous output depreciates 20 percent from initial values.
LED	Light Emitting Diode
METS	Material Engineering and Testing Services of the Translab
MacAdam	Shape on the CIE chromaticity diagram that illustrates how much one can “stray” from the target before perceiving a difference from the target color.
NEMA	National Electrical Manufacturers Association
NRTL	Nationally Recognized Testing Laboratory
NVLAP	National Voluntary Laboratory Accreditation Program - A program under the US DOE to accredit independent testing laboratories to qualify.
PF	Power Factor - The ratio of the real power component to the total (complex) power component.
Rated power	Power consumption that the luminaire was designed and tested for at ambient temperature (70°F or 21°C).
RoHS	Compliance aims to restrict certain dangerous substances commonly used in electronic equipment, including Lead, Cadmium, Mercury and others.

SPD	Surge Protection Device - A subsystem or component(s) that can protect the unit against short duration voltage and current surges.
SSL	Solid State Lighting
THD	Total Harmonic Distortion - The amount of higher frequency power on the power line.

1.3 SUBMITTALS

- A. See Section 013000 – Administrative Requirements, for submittal procedures
- B. Shop drawings: Clearly indicate luminaire type, name of the job, and Architect. Contractor shall submit all luminaire, driver and integral controls shop drawings at one time, in one package. Re-submittals shall include all luminaire, driver and integral controls previously rejected or requiring further information. Specialty SSL, custom, or modified fixtures may be submitted as a separate package.
- C. Shop Drawings: Reproductions of the contract drawings are not acceptable as shop drawings.
- D. Product Data: Provide dimensions, ratings and specific catalog number and identification of items and accessories and performance data.
- E. Shop Drawings: Indicate any components for each luminaire that are not a standard product of the manufacturer.
- F. Wiring Diagrams – as needed for special operation or interaction with other system(s)
- G. Photometric Data: Where indicated below or for substitutions, supply complete photometric data for the fixture, including optical performance, rendered by NVLAP approved laboratory developed according to the methods of the Illuminating Engineering Society of North America. Submit electronically, in IESNA LM-63 standard format.
- H. Submit photometric data for all substitute luminaries. Photometric reports are not required from specified manufacturer unless noted in 1.5.7 above.
- I. Specification Sheets: If lacking sufficient detail to indicate compliance with contract documents, standard specification sheets will not be accepted. This includes, but is not limited to, luminaire type designation, manufacturer's complete catalog number, voltage, LED type, CCT, CRI, specific driver information, system efficacy, L80 life rating, and any modifications necessary to meet the requirements of the contract documents.
- J. Substitutions shall include complete photometric data as outlined in paragraph 1.5.7 above, and point by point calculations for the specific conditions on the project. Samples shall be required for consideration of any substitutions and must be submitted in accordance with the terms outlined in paragraph 1.5.11 below.
- K. Working Samples of all substitutions: Samples shall be 120 volt with cord and plug attached, and shall include specified LEDs and all modifications necessary to meet the requirements specified in the Contract Documents.

PART 2. PRODUCT REQUIREMENTS

2.1 MANUFACTURERS

- A. Approved Manufacturers: Provide products of firms regularly engaged in the manufacture of recessed lighting fixtures and components of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years. The

manufacturer of the lighting fixtures and components shall comply with the provisions of the appropriate code and standards. All fixtures shall be pretested before shipping.

- B. Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.
- C. Codes: Materials and installation shall be in accordance with the latest revision of the National Electrical Code and any applicable Federal, State, and local codes and regulations.
- D. UL: All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL 8750 or others as they may be applicable. A listing shall be provided for each fixture type, and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view.
- E. Luminaire shall be DLC Certified (Design Lights Consortium).
- F. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
- G. Base Bid Manufacturers: Are listed on fixture schedule and specification. Manufacturers listed without accompanying catalog numbers are responsible for meeting the quality standards and photometric distribution set by the specified product.
- H. Alternate Manufacturers: Identification by means of manufacturers names and catalog numbers is to establish basic features, quality and performance standards. Any substitutions must meet or exceed these standards.
- I. Luminaire shall carry the Lighting Facts label, verified based on LM-79 test reports.
www.lightingfacts.com

2.2 LUMINAIRES TYPE XX, YY – Linear Pendant

- A. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply) and integral controls as per this specification.
- B. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
- C. The operating temperature range shall be 0°C to +25°C.
- D. Each luminaire shall meet all parameters of this specification throughout the minimum operational life of 50,000 hours when operated at the average operating temperature (see 2.2.2).
- E. Nominal luminaire dimensions:
 - 1. Type XX – Length – 4' (121.0cm), Width – 8 1/4" (21.0cm), Depth – 1 3/4" (4.45cm)
 - 2. Type YY - Length – 8' (242.0cm), Width – 8 1/4" (21.0cm), Depth – 1 3/4" (4.45cm)
- F. Luminaire Construction:
 - 1. Luminaire housing to have no visible welding, screws, springs, hooks, rivets, bare LEDs, or plastic supports.
 - 2. The luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply and circuit board for the luminaire shall be integral to the unit.

3. Luminaires shall be fabricated from post painted cold rolled 18 GA steel and shall be a rigid structure with die cast end caps, mechanically attached with no visible fasteners. Luminaire may be mounted and wired in continuous rows.
4. Finish: Polyester powder coat painted in white, black or painted aluminum as per specification. *(Specifier to edit for color selection or custom color with color reference number).*
5. Luminaire lengths in single sections of 4' or 8' shall have exact suspension spacing of 4' or 8'. Overall length – add 5/8" for flat end cap and 4" for sculpted end cap.
6. Luminaire lengths of 4' or 8' shall be joined to create a continuous run using internal joiners as shown on drawings.
7. Optics – Engineered optical systems of high performance lens, diffusers and metal reflectors.
8. Lens shall be single clear diffuser with advanced optical film and shall provide LED concealment and even illumination across the diffuser.
9. Polymeric materials (if used) of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VO flame retardant materials. Luminaire lenses are excluded from this requirement.
10. Suspension shall be aircraft wire with total suspension length as specified. Cable to be field adjustable.
11. The assembly and manufacturing process for the SSL luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration and prevent light leaks at all visible joints.

G. LED Sources

1. LEDs shall be manufactured by Nichia.
2. Lumen Output – minimum initial delivered lumen output of the luminaire shall be as follows for the lumens exiting the luminaire in the 0-360 degree zone - as measured by IESNA Standard LM-79-08 in an accredited lab. Exact tested lumen output shall be clearly noted on the shop drawings.
 - a. Type XX – 8 1/4" x 4' – 3400 (30 watts max.) or 4800 (45 watts max.) nominal delivered lumens @ 3500K per specification
 - b. Type YY – 8 1/4" x 8' – 6800 (60 watts max.) or 9600 (90 watts max.) nominal delivered lumens @ 3500K
 - c. Lumen output shall not decrease by more than 20% over the minimum operational life of 50,000 hours at the rated ambient operating temperature (see 2.2.2)
3. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the all LEDs within the luminaire.
4. LED Boards shall be suitable for field maintenance and have plug-in connectors. LED boards shall be upgradable.
5. Light Color/Quality-
 - a. Correlated Color Temperature (CCT) range as per specification, between 3000K, 3500K and 4000K shall be correlated to chromaticity as defined by the absolute (X, Y) coordinates on the 2-D CIE chromaticity chart. *(Edit color temperature per project specification)*
 - b. Color shift over 6,000 hours shall be <0.007 change in u' v' as demonstrated in IES LM80 report.
 - c. The Color Rendition Index (CRI) shall be 80 or greater.
 - d. LED boards to be tested for color consistency and shall be within a space of 2.5 MacAdam ellipses on the CIE chromaticity chart.

H. Power Supply and Drive

1. Driver: Acceptable manufacturer: eldoLED
2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.

3. Driver shall be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that do not meet these requirements will not be accepted.
4. Electrical characteristics: 120 – 277 volt, UL Listed, CSA Certified, Sound Rated A+. Driver shall be > 80% efficient at full load across all input voltages. Input wires shall be 18AWG solid copper minimum.
5. Dimming: Driver shall be suitable for full-range dimming. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, inaudible in 26db environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100 percent to 0.1 percent of rated lumen output with a smooth shut off function.
 - a. Dimming shall be controlled by a 0-10V signal.
 - b. Driver shall include ability to provide no light output when the analog control signal drops below 0.5V, or the DALI/DMX digital signal calls for light to be extinguished and shall consume 0.5 watts or less in this standby. Control deadband between .5 and .65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.
 - c. Driver shall be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
 - d. Driver must be capable of 20 bit dimming resolution for white light LED driver.
 - e. Drivers shall track evenly across multiple fixtures at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.
(Specifier: To provide similar visual performance and illumination quality to existing fluorescent dimming solution, system should minimize flicker.)
6. Flicker: Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have:
 - a. Less than 1 percent flicker index at frequencies below 120 Hz.
 - b. Less than 12 percent flicker index at 120 Hz, and shall not increase at greater than 0.1 percent per Hz to a maximum of 80 percent flicker index at 800Hz.
(Specifier: Alternative to above: choose a luminaire that shall have flicker index below 800 Hz of 5 percent or less, which is equivalent to incandescent dimming.)
7. Driver disconnect shall be provided where required to comply with codes.
8. The electronics/power supply enclosure shall be internal to the SSL luminaire and be accessible per UL requirements.
9. The surge protection which resides within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 2002 for Location Category A, where failure does not mean a momentary loss of light during the transient event.

I. Electrical

1. Power Consumption: Maximum power consumption, +/- 5% when operating between 120 – 277V (or 346V) shall be as follows:
 - a. Type XX – 8 ¼" x 4' – 30 watts and 45 watts nominal
 - b. Type YY - 8 ¼" x 8' – 60 watts and 90 watts nominal
2. Operation Voltage - The luminaire shall operate from a 60 HZ ±3 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage of (+/- 10%) shall have no visible effect on the luminous output.

3. Power Factor: The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.
 4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.
 5. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
(Specifier: The following statement ensures that the electronic dimming driver will meet NEMA inrush recommendations to reduce false circuit breaker tripping due to turn on inrush)
 6. In Rush Current: Meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 Amps² – seconds.
 7. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI emissions.
 8. Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
 - a. Adjustment of forward LED voltage, supporting 3V through 60V.
 - b. Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1mA.
 - c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.
 9. Electrical connections between normal power and driver must be modular utilizing a snap fit connector. All electrical components must be easily accessible after installation and be replaceable without lowering the luminaire.
 10. All electrical components shall be RoHS compliant.
- J. Photometric Requirements
1. Luminaire performance shall be tested as described herein.
 2. Luminaire performance shall be judged against the specified minimum illuminance in the specified pattern for a particular application.
 3. Luminaire lighting performance shall be adjusted (depreciated) for the minimum life expectancy (Section 2.2.4).
 - a. The performance shall be adjusted (depreciated) by using the LED manufacturer's data or the data from the IESNA Standard TM-21 test report, which ever one results in a higher level of lumen depreciation.
 - b. The ratio of the peak-to-zenith maximum candela ratios shall be – 1.94:1 @ 127.5 degrees.
 - c. The luminaire may be determined to be compliant photometrically, if:
 - 1) The initial minimum illuminance level is achieved in 100% of the area of the specified lighting pattern.
 - 2) The measurements shall be calibrated to standard photopic calibrations.
(Specifier: Add specific project requirements.)
- K. Thermal Management
1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life (Section 2.2.7 (c)).
 2. The LED manufacturer's maximum junction temperature for the expected life (Section 2.2.7 (c)) shall not be exceeded at the average operating ambient (Section 2.2.2).
 3. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient temperature (Section 2.2.3).

4. The luminaire shall have a UL or CSA rating.
 5. The Driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating ambient temperature. Thermal management shall be passive by design. The use of fans or other mechanical cooling devices shall not be allowed.
- L. Optics
1. Optics shall consist of high performance advanced optical film, diffuser, and metal reflector.
 2. Optics shall eliminate source image.
- M. Digital Controls
1. Each luminaire shall be equipped with one (1) digital RJ45 port and interface with other digital control equipment.
 2. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
 3. Digital manual wall control shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.
 4. Digital occupancy sensor shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.
 5. Digital photocell shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.
 6. Integral Daylight Dimming or Daylighting Dimming with Occupancy Detections sensors shall be provided as per specification. Sensor shall be designed to be low profile to minimize appearance in luminaire.
 7. Lumen Management: The luminaire shall be capable of continuously monitoring system performance to allow for constant lumen management / compensation function. Lumen output to be maintained at 80% for life of the luminaire, initial input to be 80% of rated input watts and climb to rated watts by end of rated life. Energy savings shall be 20% initially and 10% over the rated life of the luminaire
 8. Each luminaire shall be supplied with a unique network address. This address shall be printed on two identification labels. One label shall be permanently affixed to the luminaire and one label shall be easily removed for network control commissioning purposes. Both labels shall be in a location which is easily accessible by the installing contractor.
 9. Control Input:
 - a. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
 - 1) Must meet IEC 60929 Annex E for General White Lighting LED drivers
 - 2) Must meet ESTA E1.3 for RGBW LED drivers
 - b. Digital (DALI Low Voltage Controlled) Dimming Drivers:
 - 1) Must meet IEC 62386
- N. Luminaire Identification
1. Each luminaire shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked inside each unit and the outside of each packaging box.
 2. The following operating characteristics shall be permanently marked inside each unit: rated voltage and rated power in Watts and Volt-Ampere.
- O. Quality Assurance
1. The luminaires shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of the modules built to meet this specification. These tests shall include: CCT, CRI, Lumen output, and wattage. Tests shall be recorded, analyzed and maintained for future reference.

2. QA process and test results documentation shall be kept on file for a minimum period of seven years.
 3. LED luminaire designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.
- P. Design Qualification Testing
1. Design Qualification Testing shall be performed by a National Voluntary Laboratory Accreditation Program (NVLAP) testing facility. Such testing may be performed by the manufacturer or an independent testing lab hired by the manufacturer on new luminaire designs and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or physical), which changes any of the performance characteristics of the luminaire, results in a different circuit configuration for the power supply, or changes the layout of the individual LEDs in the module.
 2. A quantity of two units for each design shall be submitted for Design Qualification Testing.
 3. Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but are not limited to):
 - a. Maximum power in Watts.
 - b. L80 in hours, when extrapolated for the worse case operating temperature (section 2.2.3). TM21 report shall be submitted to demonstrate this.
 - c. Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.
 4. Luminaire shall be tested per IESNA LM 79-08.

2.3 WARRANTY

- A. The manufacturer shall provide a single source, 5 year limited warranty against loss of performance and defects in materials and workmanship for all components of the luminaire. Warranty is from the time of acceptance of the Luminaires. All warranty documentation shall be provided to customer prior to the first shipment.
- B. Provide manufacturer's warranty covering 5 years on drivers from date of purchase. Refer to [manufacturer's terms and conditions on the website](#) for detailed information.

PART 3. EXECUTION

3.1 INSTALLATION

- A. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 501.
- B. Fixture to suspend by aircraft wire to the mounting height specified. Adjustable cable gripper shall be provided as per specification. *(delete if adjustable cable gripper is not required)*. Luminaires shall be mounted straight and plumb. Contractor shall verify ceiling type and shall obtain all required mounting hardware for specific ceiling type.
- C. Canopies shall be provided.
- D. Cord Managers shall be provided to ensure the power cords and CAT5E cables can be coupled with the aircraft cables creating one line from the fixture to the ceiling.
- E. Install all required hardware and mounting brackets to secure luminaires to structure per local code requirements.
- F. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 014000.
- B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- C. Test and calibrate all controls associated with luminaires, i.e. integral photo cells and occupancy sensors.

3.3 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from lens and enclosures
 - 1. For cleaning acrylic lenses or diffusers, use a feather duster or dry cotton cheesecloth to rid the lens/diffuser of any minor dust. For fingerprints, smudges, or other dirt present, use an ammonia-based cleaner (such as Windex) and wipe carefully with cotton cheesecloth (so as to avoid injury from any prismatic texture of the lens).
 - 2. Contractor shall replace the lens if Job site contamination cannot be removed using the above recommendations.
- C. Clean photometric control surfaces as recommended by manufacturer.

3.4 CLOSEOUT ACTIVITIES

- A. Replace any luminaire components or associated controls which are not functioning per specifications.

END OF SECTION

SECTION 27 00 00

COMMUNICATIONS REQUIREMENTS

PART 1 GENERAL

1.1 PURPOSE

- A. The intent of this document is to provide a standard specification that will be used for all UNLV facilities requiring cable installation. This document provides the minimum performance criteria for the components and sub-systems comprising a complete cabling system that shall accommodate UNLV's requirements in excess of ten years.
- B. Product specifications, general design considerations, and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types for a specific UNLV facility will be provided as an attachment to a Request for Proposal. If the bid documents are in conflict, the Request for Proposal specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cabling system described in this document.
- C. This specification is intended to provide general design guidelines for new construction, and performance criteria for additions/renovations to existing facilities. Since all new construction will have telephone/data communication service raceways provided by an electrical subcontractor under the general contract, the specifications included in this document are intended as supplemental information to insure an acceptable, effective installation.
- D. The successful contractor is required to furnish all labor, supervision, tooling, miscellaneous mounting hardware and consumables for each cabling system installed. The contractor shall maintain current status with the warranting manufacturer, including all training requirements, for the duration of the contract. The Contractor shall staff each installation crew with the appropriate number of trained personnel, in accordance with their warranty. After installation, the Contractor shall submit documentation to support a contractor installation 10-year warranty. The 10-year warranty will cover the components and labor associated with the repair/replacement of any failed link, which is a valid warranty claim, within the warranty period.

1.2 APPLICABLE REGULATIONS

- A. Related Documents – Equipment and material shall be Underwriter's Laboratories listed and labeled. The latest editions of the following standards are minimum requirements. If a conflict exists between applicable documents, then the order in the list below shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency:
 - 1. ANSI/TIA/EIA- Transmission Performance Specifications for 4-Pair Category 6 Cabling.
 - 2. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard
 - 3. ANSI/EIA/TIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces
 - 4. ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Building
 - 5. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
 - 6. National Electrical Manufacturers Association (NEMA)
 - 7. National Electrical Code, latest revision (NEC)
 - 8. National Fire Protection Agency (NFPA) – 70

9. Local, State and Federal Codes including Nevada Revised Statute (NRS) 278.583
10. Nevada State Public Works Board Adopted Standards
11. UL 497 Protectors
12. UL 1459 Standard for Safety for Telephone Equipment
13. UL 1863 Standard for Safety for Communications Circuit Accessories
14. UL 2024 Standard for Safety for Optical Fiber Cable Raceway
15. UL 723 Standard for Safety for Surface Burning Characteristics of Building Materials
16. UL 1581 Standard for Safety for Reference Standard for Wires, Cables and Flexible Cords
17. TIA SP-4195
18. National Electrical Safety Code (NESC)
19. ANSI/EIA 310D

1.3 DESIGN REQUIREMENTS

- A. Work must conform to the design requirement for each identified element.
- B. Building Service - Plans for all new buildings shall include a design for extending the campus voice, data and video networks to the building. Consistent with this design, network trunks shall be extended as a part of the initial construction and equipment shall be installed to provide connection to the building. Every building, regardless of size, shall be constructed to allow for a 19-tube cable (Sumitomo part number TC19TLW or similar) to enter through individual 4" conduits from the campus underground plant from two diverse locations. Voice cables (minimum 50 pair) to enter from the campus underground plant from one location. In addition, every building shall be equipped with at least two empty 4" conduits to the campus underground plant for later use by UNLV after installation of all voice and data cables. All raceways to have 880 lb. nylon pull strings installed. All new service entrance conduits shall be a minimum 4" trade size and of sufficient number to provide 50% growth capacity, and will terminate 4" above finished floor in the MDF (main distribution frame) room inside the building.
 1. Service Data: Data communication service to each building shall consist of a minimum of 24 strands of 50/125-micron multi-mode fiber and 72 strands of 9.0/125-micron single-mode fiber and terminated at two separate major distribution locations on campus as determined by UNLV Network Development and Engineering. Fiber optic cable is to be contained in its own 19-tube air-blown cable, Sumitomo part number TC19TLA or similar. If different part number is to be used, approval must be granted by UNLV Network Development and Engineering. Multi-mode fiber is to be terminated with LC style connectors, UPC Polish and single-mode fiber is to be terminated with SC style connectors, UPC Polish. Multimode and Singlemode terminated in separate rack mounted light guides. MDF to include a Tube Distribution Unit (Sumitomo part number DE12IDU or similar). If different part number is to be used, approval must be granted by UNLV Network Development and Engineering. Each light guide must be labeled with building, and IDF room number of opposing end. Patch panels to be mounted in such a manner as to allow the maximum usage of each rack. Appropriate wire management, determined by consultation with Network Development and Engineering and with regards to building design, shall be installed. A minimum of 10 ft. of fiber-optic cable will be coiled, to meet manufacturer specifications, at both termination points. Complete IDF room design, including rack layout, power requirements, cable management will be provided by UNLV Network Development and Engineering.
 2. Service – Voice: Voice communication service to each building shall consist of a minimum of one 24 AWG, solid annealed copper, 50 pair twisted cable. Cable to enter building through a separate, dedicated conduit. Cable to be terminated patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue. Lightning protection to be provided as required per design specifications and/or applicable codes and regulations.

- C. Service Entries - Elements of the service entry facilities design are to include type, size, gauge, and insulation of distribution cables. Every copper cable shall be bonded and grounded for lightning protection per NEC 800-30A at both terminations using solid-state 5-pin protectors, 50 to 100 volt range. Building entry conduit shall allow for 50% growth and have a minimum of four 4" conduits from manhole to MDF room.
- D. Manholes - All manholes shall be at minimum 4' by 4' by 4' and encased in concrete. All cable is to have service loops and be racked and mounted. Each manhole will have drainage holes and be engineered so water will not accumulate. Top of manholes are to be flush with paved areas, 6" above finished grade in landscaped areas.
- E. Cable Splicing – Copper cable splicing is only allowed where previously approved by UNLV Network Development and Engineering. Fiber-optic cable will only be spliced at the termination point. Fiber-optic splicing must be fusion based with two fibers optic strands of the exact make and model on each end using factory terminated connectors on pigtails. Splicing is not acceptable outside of Tele/Data rooms. Epoxy based splices shall not be acceptable. The following cable splicing techniques and materials for copper cable shall be utilized:
 - 1. Preparation for Splices – All copper cables shall be thoroughly cleaned and scuffed in a manner to insure a good mechanical bond when splicing. 3M Scotchcase 4435 non- conductive aluminum oxide abrasive strip, or UNLV approved equal shall be used. All cable shall be thoroughly cleaned with a non-toxic solvent, 3M Scotchcase 4414 or 4415 or UNLV approved equal.
 - 2. Splicing Requirements
 - a. No splice cases will be permitted in cable trays.
 - b. All splice closures for use on underground non-pressurized systems shall be manufactured of clear, self-extinguishing, tongue and groove fitting PVC.
 - c. End caps must be tapered and flexible and be capable of separate cable entries.
 - d. Rigid bonding and strain relief bars must be an integral part of the finished closure.
 - e. Re-enterable, polyurethane compound shall be used.
 - f. All cable splices must be tagged or marked showing the cable number and pair count spliced. Markings may be placed on the splice closure or on both the in and out cables.
 - g. Supports: All cable splices shall be supported by a minimum of two cable hooks. Horizontal racking for support may utilize 3M Brand RC-100 rack adapters, manhole racks, or library approved equivalent.
 - h. Closures: 3M splice closures or library approved closures will be used for splicing throughout the system.
 - i. Protection: All cable splices must be protected from damage at sheath openings by mechanically protecting all conductors utilizing 3M Scotchcase Pair Saver 4458 or approved equivalent.
- F. Building Voice and Data Terminal Rooms – All new building structures shall have minimum one primary Data communication room in which the outside cable terminates, henceforth referred to as the Main Distribution Facility (MDF). Each building may have additional data rooms for end wiring, henceforth referred to as Intermediate Distribution Facilities (IDFs).
 - 1. Main Distribution Facility (MDF) Specifications
 - a. The MDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept as clear of all other equipment.
 - b. Each MDF will be provided with isolated grounds, including a 6' vertical earth ground, and an isolated electrical panel with 200-amp service.
 - c. Each MDF will have four 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs and four 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs. All outlets will be serviced by the emergency power

- system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, near floor level.
- d. All MDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the MDF must be at least 36" wide and 80" high.
 - e. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 14' x 10', and not have false floors or ceilings.
 - f. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.
 - g. A separate HVAC thermostat control will be installed for all MDF rooms, and shall be air conditioned with separate zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.
 - h. All MDFs shall be secured using a Marlock card swipe reader and striker, the access of which is to be managed by the Network Operations Center.
 - i. All MDFs shall be provisioned with at least one standard data rack, Panduit CMR4P84CN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36" of clearance front and back and at least 18" on both sides. OIT provided room drawings must be followed.
 - j. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.
 - k. A minimum of two walls must be covered by backboards as defined in Part II.
 - l. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.
 - m. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569 or better.
2. Intermediate Distribution Facilities (IDFs)
- a. The IDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept as clear of all other equipment.
 - b. Each IDF will be provided with isolated grounds, including a 6' vertical earth ground.
 - c. Each IDF will have four 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs and two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs. All outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, near floor level.
 - d. All IDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the IDF must be at least 36" wide and 80" high.
 - e. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 8' x 10', and not have false floors or ceilings.
 - f. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.
 - g. A separate HVAC thermostat control will be installed for all IDF rooms, and shall be air conditioned with separate own zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.

- h. All IDFs shall be secured using a Marlock card swipe reader and striker, the access of which is to be managed by the Network Operations Center.
- i. All IDFs shall be provisioned with at least one standard data rack, Panduit CMR4P84CN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36" of clearance front and back and at least 18" on both sides. OIT provided room drawings must be followed.
- j. Enough rack space must be provided to terminate all fiber and copper, with associated cable management, plus 200%.
- k. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.
- l. A minimum of four walls must be covered by backboards as defined in Part II.
- m. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.
- n. All other elements of room to be designed and provisioned per ANSI/ EIA/TIA 569 or better.

G. Building Interiors

- 1. Underground Plant - The cables from the underground plant shall enter the building in a MDF room. Appropriate wire management shall be installed such as ladder racks, D-rings, and tie wraps so as not to exceed the acceptable cable bend radius.
- 2. Data Rooms - Additional IDF(s) shall be provided if necessary to prevent total length of data cable runs from exceeding 300 feet. Additional IDF rooms in multistory buildings shall be aligned vertically with the MDF room if possible.
- 3. Internal Backbones (Risers) - A minimum of two 4" conduits shall run between every IDF and the MDF within buildings. Pull strings shall be provided in every conduit. Data interconnections between each IDF and the MDF shall be via fiber optic cable containing a minimum of 24 strands of multi-mode and 24 strands of single-mode fiber, as defined in Part II. Fiber optic cable is to be contained inside 7-tube air-blown conduit, Sumitomo part TC07TRX. 12 Cat6 provided between every IDF and the MDF. Patch panels are to be mounted in such a manner as to allow the maximum usage of each rack.
- 4. Station Wiring
 - a. Outlets - All outlets shall be constructed using single gang, 4-port faceplates, colored almond, AMP part number 558088-1 or similar. All outlets shall have at least two network drops each.
 - b. Cabling - All drops shall be connected with blue network cabling from patch panels to each drop location and terminated on black data jack. Every cable shall be continuous and unspliced, with data cables attached to a single port in the patch panel at one end and to a single jack at the station end. All connections are to be done using the T568B wiring scheme. No cable run from patch panel to connection point may exceed 300 feet. All cabling must terminate in an IDF or MDF room on the same floor as the outlet unless building plans, certified by Network Development and Engineering, specify otherwise. Additional specifications for cabling, patch panels and data jacks as per specifications in Part II.
 - c. Habitable Space Provisioning - Every habitable space shall be provisioned a minimum of one outlet per person planned for the space or one outlet per 60 ft², whichever is greater. If the number of people planned for a space is not known, the 60 ft² guideline must be used.
 - d. Non-habitable Space Provisioning - Every non-habitable space shall be provisioned with one outlet every 500 ft², minimum of 1 per enclosed space. Exceptions may be granted for unusual circumstances by Network Development and Engineering, in writing.

- e. Labeling - The labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cable's origin and destination. Station identifiers shall increment starting from the jack at the right when facing into the room at the main entrance and incrementing counterclockwise; and shall increment from left to right then top to bottom on each individual faceplate. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated using indelible ink. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Faceplate labels will be the manufacturer's labels provided with the outlet assembly unless otherwise specified. As-builts & test results to be provided in .PDF and CAD format. The labeling schema shall be as follows:
- 1) Data Room Patch Panel - All patch panels shall be labeled in the format "### - X", where ### is the station room number, and X is the station identifier discussed above. All wireless drops must be labeled in the format "W###-X".
 - 2) Station Jack - All station jacks shall have the data drops on the patch panel and the station numbers labeled on the faceplate. The top label of the jack must be in the format of "### X-Y". ### being the station room number. "X" being the first data drop present at that faceplate location, and "Y" being the last data drop present at that faceplate location. In addition, each jack shall have an individual label placed adjacent to the jack on the perimeter of the faceplate. This label will be a single number from the X-Y range and shall be ordered from left to right and top to bottom. This number range shall start at one and increment up to the last jack in the room. The first increment for each room is one. The bottom label must also include the room number of the IDF that jack pulls to. See "Standard Outlet Configuration" in section 4.
5. Wireless – 802.11 - All wireless locations shall be mounted parallel to the ceiling, above the drop-ceiling grid panels. Two blue data cables shall run from a patch panel to data jacks in the box. These locations shall have a minimum clearance of 14" x 14" x 8". No cable run from patch panel to connection point may exceed 300 feet.
6. Wireless Access Points Placement and Wireless Overlay for 802.11 - Locations will be specified by consultation with UNLV Network Development and Engineering. The use of 3rd party professional RF Engineering design may be required under the special conditions. These conditions include but are not limited to the following:
- a. Any wireless bridge installation which requires rooftop cabling and mounting of wireless bridging hardware, antennae and masts.
 - b. Installations which require access points to use antennae other than the standard dipole antennae.
 - c. The finished ceiling plan is exposed and the customer has specified that wireless hardware and antennae placement must be as limited as possible in order to meet aesthetic requirements of the building Consultation with UNLV Network Development and Engineering is required for all 802.11 Wireless infrastructure design.
7. Cable Trays – All cable trays must be UL rated and approved by UNLV Network Development and Engineering prior to their inclusion in specifications.
- a. Supports - Cable trays for horizontal distribution cables, utilizing a center support hanger method to support the cable trays, will utilize threaded rods of not less than 1/2" in diameter.
 - b. Capacity - Cable trays shall be sized for a minimum growth of 50%.
8. Installation - Installation is to meet or exceed ANSI/EIA/TIA 568-B and ANSI/EIA/TIA 569. Completed installation is to be Certified Category 6 using the

TIA TSB-95 testing standard or better. Test documents/results to be supplied to UNLV in .PDF and Linkware format. Completed installation is to be approved by UNLV Network Development and Engineering.

9. Pull and Splice Boxes:

- a. Location - Pull boxes must be installed in easily accessible locations. It is not permissible to locate a pull box in the ceiling for conduits larger than 2" in diameter. Conduits larger than 2" diameter, entering a box shall be routed down a wall or column and the box shall be installed accordingly.

All pull boxes shall be placed in a straight section of conduit. Align the corresponding conduits at each end. All boxes shall be properly and adequately secured. They are not to be supported by the conduits entering the box. Install boxes for station cabling immediately above the suspended ceiling.

- b. Access – Provide boxes with a suitable cover.

H. Grounding

1. Regulations - All conduit and cable tray systems, supports, cabinets, equipment, etc., shall be properly grounded in accordance with the latest edition of the National Electrical Code (NEC) and all other applicable codes and regulations.
2. Installation Requirements - Provide all bonding wire and jumpers, grounding bushings, clamps, etc., required for complete grounding. Route ground conductors to provide the shortest, most direct path to the ground electrode system.
3. Grounded Connectors - Provide a separate grounding conductor, securely grounded on each side of all conduit and cable trays that do not provide a continuous, metallic path. Size shall be in accordance with the National Electrical Code (NEC). All ground connections will have clean contact surfaces, tinned and sweated while bolting. Avoid splices in bonding or grounding conductors. If splices are required they must be cad welded. Any grounding or bonding conductor that is run through a metallic conduit should be bonded to the conduit on both ends. Do not use a gas pipe as the grounding electrode.
4. IDF/MDF Room Grounding - All IDF and MDF rooms require an earth ground. Additionally, if the IDF/MDF room houses telecommunications switching or fiber remote equipment, single point of ground technology is required. This requires a separate ground bus in the service panel to the building transformer; otherwise power receptacles in the room must be isolated and grounded together with a number 6 AWG or larger copper wire.

PART 2 PRODUCTS AND ACCEPTED MATERIALS

2.1 BACKBOARDS

- A. All backboards required in the IDF/MDF rooms shall be plywood, 3/4", 4' by 8' sheets, grade A, treated on one side with fire resistant paint or material, installed with finished side exposed.

2.2 CABLE SPECIFICATIONS

- A. Data Copper - All copper data cable must be Category 6, 4 pair, UTP (Unshielded Twisted Pair). Accepted materials are Belden 2412 for non-plenum spaces, and Belden 2413 for plenum spaces. Equivalent cable must be verified by UNLV Network Development and Engineering. All terminations are to follow ANSI/ EIA/TIA 568-B.
- B. Exterior Cable - All telephone cable that supports devices external of a building such as emergency phones use Superior Essex cable part number 09-092-02,6 pair buried drop.
- C. Multimode Fiber Optic - All multimode fiber optic cable must 50.0/125 micron inside 19-tube air- blown conduit, Sumitomo part number FB24M5 (24 Strand). All multimode terminations are to be LC, UPC finish.

- D. Singlemode Fiber Optic - All singlemode fiber optic cable must be 9.0/125 micron inside 19-tube air-blown conduit, Sumitomo part number FB24SX (24 strand). All singlemode terminations are to be SC, UPC finish.

2.3 DATA TERMINATIONS

- A. Data Copper Patch Panels - All data patch panels are to be 110 block, Category 6, in either 1U, 24 port or 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements. AMP parts 1375014-1 (24 count) or 1375015-1 (48 count) or equivalent. Every group of 48 must be separated by 1U of horizontal cable management, Panduit part# NCMHF1. All terminations are to follow ANSI/EIA/TIA 568-B.
- B. Voice Copper Termination Blocks - All voice wire terminations are to be terminated on patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue.
- C. Copper Data Jacks - All modular data jacks shall be unshielded, 4-pair, 8P8C, 110 block, Category 6, black, unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements. AMP parts 1375055-2 or equivalent. All terminations are to follow ANSI/EIA/TIA 568-B.

All faceplates shall be 4 port, light almond, single gang, low profile, AMP part 558088-1 or equivalent.

- D. Fiber Optic - Multi-mode fiber is to be terminated with LC style connectors, UPC Polish and single-mode fiber is to be terminated with SC style connectors, UPC Polish. Multimode and Singlemode terminated in separate rack mounted light guides.

2.4 DATA EQUIPMENT RACKS

- A. All racks are to be four post, open frame, square hole, black, Panduit part number CMR4P84CN. Substitutions must be authorized in writing by UNLV Network Development and Engineering.

2.5 CABLE TRAYS

- A. All cable trays are to be a minimum of 18" wide by 4" deep, solid trough or ladder. Thomas & Betts #HG(PG for pre-galvanized)1-4)-18-S(L09 for ladder with 9" rung spacing)-144 or equivalent, with associated fittings, hardware, and supports.

2.6 EXCEPTIONS

- A. Exceptions may be authorized for existing buildings only with approval of UNLV Network Development and Engineering and shall be granted in writing.
- B. Examination
 1. The minimum concrete pour depth shall 3-1/2 inches (89mm).
 2. With Installer present, verify that manufacturer's requirements for floor opening and infrastructure conditions have been satisfactorily met. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Preparation
 1. Arrange for jobsite approval of the equipment prior to commencing installation.
 2. Verify exact locations of floorbox installation.
- D. Installation
 1. Install equipment in compliance with approved shop drawings and manufacturer's installation instructions.

2. Install in position and relationship to adjoining work indicated, securely anchored to supporting structure, sealed and finished, and in a manner, which produces a level box with square, plumb, and straight edges.
 3. Telecommunications Cabling Floor box shall have a total of three separate EC with pull string at each box as follows:
 - a. One 3/4-inch EC from box to circuit panel. (Duplex AC Power)
 - b. Two 1-1/4 inch EC from box to telecom cable tray A.F.C (CAT. 6 data cables).
 4. Coordinate installation with floor covering to finish each floor box. Install floor covering with oversized cable management pop-up pass- thru in top, matching surrounding floor covering in cover insert.
- E. Adjusting
1. Adjust door and cover for proper operation.
- F. Protection
1. Protect installed equipment in original undamaged condition until Substantial Completion. Remove and provide new components or units that cannot be repaired to the satisfaction of the Architect.

PART 3 EXECUTION

The UNLV has drawings detailing existing cable runs, terminal cabinets/closets, risers, etc. Copies may be obtained from UNLV Network Development and Engineering to facilitate the requirements of Part III - Execution.

Unless otherwise expressly provided in the Contract, any provisions of the standard specifications, which require the UNLV to inspect certain material or work, shall mean that the UNLV has the option, rather than the obligation, to do so. Any warranty or guarantee provisions contained in the Contractors'/Vendors' standard specifications shall be of no effect and the warranty and guarantee provisions, if any, of the Contract shall apply.

3.1 DEMOLITION

- A. Coordination with UNLV Operations - No telecommunication or data jacks, cabling terminals, or other hardware will be moved, disconnected, or removed without prior approval of UNLV Network Development and Engineering. Coordination of demolition activities with the departments will be strictly enforced to minimize service disruptions.
- B. Work to be Performed by Owner - Upon notification by contractor, UNLV Network Development and Engineering will dispatch a technician to the requested work location. The technician will determine if the facilities to be moved or removed are in service (hot) or out of service (dead). If station cabling is dead the technician will insure that all cross-connects have been removed. If the facilities to be moved or removed are determined to be in service, the technician will take the necessary actions to render the facilities dead. Under NO circumstances will removal of telecommunications or data facilities begin until UNLV Network Development and Engineering has ensured that services are dead.
- C. Disposal of Surface-Mount Raceway - Surface mount raceway that has been vacated, or otherwise determined not required, will be removed after all cabling has been properly removed.

3.2 EXCAVATION

- A. The Contractor shall be required to excavate for underground mechanical piping, and shall perform all auxiliary work that may be required to do so.

- B. No trenching will commence until UNLV Planning and Construction and UNLV Network Development and Engineering grants approval. The UNLV has drawings of existing underground utilities to assist the Contractor to locate all underground utilities. All Contractors are to Call Before U Dig. All lines damaged by Contractor will be repaired at Contractor's expense.
- C. Asphalt and concrete pavement shall be sawed or cut to a depth necessary to bring about a straight-line break parallel to the sides of the trench, so as not to disturb the adjoining pavement.
- D. All underground construction work, during progress and after completion, shall conform truly to lines and grades. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. If the trench is excavated to a greater depth than that given, the Contractor shall, at his own expense, bring such excavation to required grade with such material as directed, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable materials.
- F. The material excavated shall be deposited along the side of the trench in such a manner as to create the least inconvenience possible.
- G. Contractor shall not obstruct the gutter of any street or driveways, but shall use all proper means to provide the free passage of surface water along the gutters into storm water inlets. Contractor shall provide channels where required.
- H. Special care shall be taken to keep all fire hydrants and gate valves on water mains accessible at all times. Fire lanes are to be kept open.
- I. Wherever required, sides of the trench shall be sheeted and braced in strict accordance to the rules, orders and regulations of the State, County, and the City. Trenches shall be barricaded.
- J. Grass will be replaced by a method approved by the UNLV.
- K. Bricks, blocks and other debris removed from trenches will not be used as fill for trenches.

3.3 INSTALLATION

- A. Regulations - All work and materials will comply with all federal and State laws, municipal ordinances, codes, regulations and direction of inspectors appointed by proper authorities having jurisdiction.

If there are violations of codes, the vendor will correct the deficiency at no cost to the UNLV.

Working conditions must meet the industry standards for safety and work procedures, and protection of property established by prevailing rules, regulations, codes, and ordinances.

- B. Quality Assurance - Workmanship and neat appearance shall be as important as the mechanical and electrical efficiency of the system. All testing and clean-up shall be completed to the satisfaction of UNLV Network Development and Engineering before sign-off. This includes, but is not limited to, cable testing, proper labeling, debris removal, and proper cable bundling and routing.
- C. Damage of Existing Facilities - The Contractors shall be responsible for replacing, restoring, or bringing to at least original condition any damage to floors, ceilings, walls,

furniture, grounds, pavement, etc., caused by its personnel and operations. Any damage or disfiguration will be restored at the Contractor's expense.

- D. Coordination - Contractor is responsible for insuring minimal disruption of existing television, telemetry, telephone and data communications facilities and networks.

Outages shall be scheduled only with permission from UNLV Network Development and Engineering at its convenience.

All work areas shall be cleared of all litter, and properly disposed of by Contractor on a daily basis.

At its own expense, Contractor shall erect temporary fencing where required or deemed necessary by UNLV personnel, or where deemed necessary by the Contractor for securing materials.

Contractors shall provide all necessary temporary equipment and material, shall maintain them in a safe and adequate manner, and shall remove them immediately upon completion of work requiring their presence.

- E. Cable Support and Anchors - All cables, wires and equipment will be firmly anchored. Fasteners and supports shall be adequate to support loads with ample safety factors.

- F. Firestop Systems - A firestop system is comprised of an item or items penetrating a fire rated structure, the opening in the structure, the sealing materials, and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, heat, vapor and pressurized water stream. All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped using state approved fire resistant materials installed in accordance with the manufacturer's tested methods. All penetrations through fire rated surfaces shall comply with the following:

1. ASTM E 84: Standard Test Methods for Surface Burning Characteristics of Building Materials
2. ASTM E 119: Methods of Fire Tests of Building Construction Materials
3. ASTM E 814: Standard Method of Fire Tests of Through-Penetration Firestops
4. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement
5. ASTM C 920: Standard Specification of Elastomeric Joint Sealants
6. UL 263: Fire Tests of Building Construction Materials
7. UL 723: Surface Burning Characteristics of Building Materials
8. UL 1479: Fire Tests of Through Penetration Firestops
9. UL 2079: Standard for Fire Tests of Joint Systems

- G. Conduit - Conduit shall be Electrical Metallic Tubing produced in accordance with ANSI C80.3 standard and run in the most direct route practical.

Conduit runs containing more than two 90-degree bends, or a reverse (180 degree) bend require a pull box.

All offsets shall be considered equivalent to a 90-degree bend.

Conduit bend radii will be a standard ten times the outside diameter of conduit unless otherwise approved by UNLV Network Development and Engineering.

Conduits entering the IDF through the wall shall be reamed or bushed, and terminated not more than 4 inches from the wall surface.

Conduits entering the IDF from below shall be terminated 4 inches above finished floor.

Conduit runs for distribution cables (both horizontal and vertical), except station outlets, shall be not less than 4" in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.

Conduit installed for data and/or voice cabling may not be shared with any other cable.

All conduit runs for station outlets shall be not less than 3/4" in diameter.

All conduit runs for station outlets with more than 3 cables shall be not less than 1" in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.

After installation, all conduits shall be clean, dry, unobstructed, capped for protection and labeled with their destination (by room number) for identification.

Allowable fill capacity is 40% or as defined by the National Electric Code, whichever is lower.

Conduit runs for horizontal distribution cables, utilizing the trapeze hanger method to support the conduits, shall utilize threaded rods of not less than 3/8" in diameter.

Conduit shall not block access to existing services.

- H. Cable Installation - All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer's specified Minimum Bend Radius for each type of cable. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.

Any cable to be placed through an electrical room or any other potentially hazardous conditional shall be placed in conduit.

All cable will be secured to the backboard in such a manner as to allow cross connections to be made without crossing over any cables.

All outlets will have a minimum of eight (8) inches of cable stored at each drop after the cable has been terminated.

Where considerations of practicality eliminate the installation of conduit, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate wire hangers/supports or dressing will be used.

Cables are to be anchored to the wall extensions, existing conduits, pipe, or duct work in a neat manner.

Cable pulled in a cable tray with existing cable should not be pulled where stress would be applied to the existing cable.

All cable is to be terminated at both ends, tested, labeled and ready to provide service to and within the building.

Installation to meet or exceed ANSI/EIA/TIA 568B and ANSI/EIA/TIA 569. UNLV Network Development and Engineering must approve completed installation.

- I. Cable Testing - All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. The contractor, prior to system acceptance, shall verify all conductors of each installed cable. Any defect in the cabling system installation including but not limited to cable, connectors,

feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% usable conductors in all cables installed.

1. Data Copper - All Data cables shall be tested in accordance with ANSI/TIA/EIA Category 6 Standard Performance Specifications for 4-Pair 250 Ohm Category 6 Cabling using TIA TSB-95 or better, and best industry practices. If any of these are in conflict, the Contractor shall be responsible to bring any discrepancies to the attention of UNLV Network Development and Engineering.
 - a. Testing - Each cable shall be tested for continuity on all pairs and/or conductors. Twisted-pair voice cables shall be tested for continuity, pair reversals, and shorts. Twisted-pair data cables shall be tested for all of the above requirements, plus tests that indicate installed cable performance. The data cables shall be bi-directional tested using a Class II-E or better cable analyzer.
 - 1) Continuity - Each pair of each installed cable shall be tested for opens, shorts, polarity and pair-reversals. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
 - 2) Length - Each installed cable shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multipair cables, the longest pair length shall be recorded as the length for the cable.
 - 3) Performance Verification - Enhanced Category 6 data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests: near end crosstalk (NEXT), attenuation, ambient noise, and attenuation to crosstalk ratio (ACR).
 - 4) Equipment - Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test result and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF and Linkware format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.
2. Fiber Optic - Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA Standard, and the result shown as pass/fail. The test results shall include all tests performed, the expected test result and the actual test result achieved. All test results to be provided to the UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

Test evaluation for the panel to panel (backbone) shall be based on the values set forth in the EIA/TIA-568-B Annex H, Optical Fiber Link Performance Testing.

Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light

source shall be left in place after calibration and the power meter moved to the far end to take measurements.

The expected results for each cable (or group of cables of the same nominal length) shall be calculated before the start of testing and recorded in a space provided on the Contractor's test matrix. Each strand of fiber in the respective cable shall be evaluated against this target number. Any fibers that exceed this number by more than -0.5dB shall be repaired or replaced at the installers' cost.

Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between UNLV Network Development and Engineering and the Contractor prior to the start of the test.

- a. Multimode - All multimode optical fiber attenuation shall be measured at 850 nanometers (nm) and 1300 nm using an LED light source and power meter. Test set-up and performance shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, Method B. One 2-meter patch cord shall be used for the test reference and two 2-meter patch cords shall be used for the actual test. This test method uses a one-jumper reference, two-jumper test to estimate the actual link loss of the installed cables plus the loss of two connectors. This measurement is consistent with the loss that network equipment will see under normal installation and use. Test evaluation for the panel to panel (backbone) or panel to outlet (horizontal) shall be based on the values set forth in the EIA/TIA-568-A Annex H, Optical Fiber Link. Multimode fiber optic cable must meet or exceed the following limits:
 - 1) Attenuation - 3.5dB/km at 850nm, 1.5dB/km at 1300nm.
 - 2) Bandwidth - 1500MHz*km at 850nm, 500MHz*km at 1300nm.
 - 3) Connectors - Max loss for a mated pair of connectors shall be less than 0.5dB.
- b. Singlemode - Single mode optical fiber attenuation shall be measured at 1310 nm and 1550 nm using a laser light source and power meter. Tests shall be performed at both wavelengths in one direction on each strand of fiber. The set-up and test shall be performed in accordance with EIA/TIA-526-7 Standard, Method 1A. Two-meter patch cords shall be used as test references and for the actual test. This test method utilizes a one-jumper reference, two-jumper test to estimate the actual link loss of the install cable plus two patch cords. Singlemode fiber optic cable must meet or exceed the following limits:
 - 1) Attenuation - 0.4dB/km at 1310nm, 0.3dB/km at 1550nm.
 - 2) Connectors - Max loss for a mated pair of connectors shall be less than 0.5dB.
3. OTDR - Each cable shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses. The OTDR measurements for length shall be performed in accordance with EIA/TIA- 455-60. The measurements to determine splice loss shall be performed in accordance with manufacturer's recommendations and best industry practices.
4. As-Built - All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. The As-built drawings shall clearly identify the patch panel label and it's corresponding station side location. As-builts will be created from latest digital architectural drawings, to most closely resemble exact building conditions, as possible. Hand drawings are not acceptable. As-builts & test results must be provided in both .PDF and CAD format. Upon acceptance of contract, vendor will be required to provide an acceptable time-line for provision of As-Built drawings. Acceptable time-line shall be verified by UNLV Network Development and Engineering. Ample time must be allocated for verification of As-builts & test results and subsequent corrected

versions of those documents. Network equipment (Including Voice, Data and A/V services) will not be provisioned until this documentation is provided.

END OF SECTION

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding rods.
 - 5. Grounding labeling.

1.03 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding busbar.
- D. TMGB: Telecommunications main grounding busbar.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.05 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. Ground rods.
 - 2. Ground and roof rings.
 - 3. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. Qualification Data: For Installer, installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. Result of the ground-resistance test, measured at the point of BCT connection.
- b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Installer 2, who shall be present at all times when Work of this Section is performed at Project site.
 - 2. Field Inspector: Currently registered by BICSI as a registered communications distribution designer to perform the on-site inspection.

PART 2 PRODUCTS

2.01 SYSTEM COMPONENTS

- A. Comply with J-STD-607-A.

2.02 CONDUCTORS

- 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. Harger Lightning and Grounding.
 - 2. Panduit Corp.
 - 3. Tyco Electronics Corp.
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG 26 kcmils and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
 - 2. Not smaller than No. 10 AWG 26 kcmils and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.03 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. 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:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Chatsworth Products, Inc.
 - 3. Harger Lightning and Grounding.
 - 4. Panduit Corp.
 - 5. Tyco Electronics Corp.
- D. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 - 1. Electroplated tinned copper, C and H shaped.
- E. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- F. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.
- G. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.04 GROUNDING BUSBARS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Chatsworth Products, Inc.
 - 2. Harger Lightning and Grounding.
 - 3. Panduit Corp.
- C. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, [1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch.

3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- E. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.
1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
 2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
 3. Rack-Mounted Vertical Busbar: 72 or 36 inches stainless-steel or copper-plated hardware for attachment to the rack.

2.05 GROUND RODS

- 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. Harger Lightning and Grounding.
 2. Tyco Electronics Corp.
- B. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

2.06 LABELING

- 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. Brother International Corporation.
 2. HellermannTyton.
 3. Panduit Corp.
- B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with J-STD-607-A.

3.03 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.04 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMBG and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.05 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.

- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.06 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pretwist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG 168 kcmils unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.
- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- K. Access Floors: Bond all metal parts of access floors to the TGB.
- L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6AWG bonding conductors.
 - 1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
 - 2. Bond the TGB of the equipment room to the reference grid at two or more locations.
 - 3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- M. Towers and Antennas:

1. Ground Ring: Buried at least 30 inches below grade and at least 24 inches from the base of the tower or mounting.
2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches below grade.
3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches below grade.
4. Bond metallic fences within 6 feet of towers and antennas to the ground ring, buried at least 18 inches below grade.
5. Special Requirements for Roof-Mounted Towers:
 - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
 - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
 - c. Connect roof ring to the perimeter conductors of the lightning protection system.
6. Waveguides and Coaxial Cable:
 - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
 - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.07 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.08 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.09 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Metal wireways and auxiliary gutters.
 - 5. Nonmetallic wireways and auxiliary gutters.
 - 6. Surface pathways.
 - 7. Boxes, enclosures, and cabinets.
 - 8. Handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.

1.06 NONMETALLIC CONDUITS AND FITTINGS

- 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. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.

3. Anamet Electrical, Inc.
 4. Arnco Corporation.
 5. CANTEX Inc.
 6. CertainTeed Corp.
 7. Condux International, Inc.
 8. Electri-Flex Company.
 9. Kraloy.
 10. Lamson & Sessions; Carlon Electrical Products.
 11. Niedax-Kleinhuis USA, Inc.
 12. RACO; a Hubbell company.
 13. Thomas & Betts Corporation.
- B. General Requirements for Nonmetallic Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651B.
- F. RTRC: Comply with UL 1684A and NEMA TC 14.
- G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.07 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- 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. Alpha Wire Company.
 2. Arnco Corporation.
 3. Endot Industries Inc.
 4. IPEX.
 5. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum or general-use installation unless otherwise indicated.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.

1.08 METAL WIREWAYS AND AUXILIARY GUTTERS

- 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. Cooper B-Line, Inc.
 2. Hoffman; a Pentair company.
 3. Mono-Systems, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: BLACK.

1.09 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- 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. Allied Moulded Products, Inc.
 2. Hoffman; a Pentair company.
 3. Lamson & Sessions; Carlon Electrical Products.
 4. Niedax-Kleinhuis USA, Inc.
- B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.10 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mono-Systems, Inc.
 - b. Niedax-Kleinhuis USA, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
- C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems Division.
 - b. Lamson & Sessions; Carlon Electrical Products.
 - c. Mono-Systems, Inc.
 - d. Panduit Corp.
 - e. Wiremold / Legrand.
- D. Tele-Power Poles:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
 2. Material: Galvanized steel with ivory baked-enamel finish.
 3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

1.11 BOXES, ENCLOSURES, AND CABINETS

- 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. Adalet.
 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 3. EGS/Appleton Electric.
 4. Erickson Electrical Equipment Company.
 5. Hoffman; a Pentair company.
 6. Hubbell Incorporated; Killark Division.
 7. Lamson & Sessions; Carlon Electrical Products.
 8. Milbank Manufacturing Co.
 9. Molex; Woodhead Brand.
 10. Mono-Systems, Inc.
 11. O-Z/Gedney; a brand of EGS Electrical Group.
 12. RACO; a Hubbell company.
 13. Robroy Industries.
 14. Spring City Electrical Manufacturing Company.

15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 16. Thomas & Betts Corporation.
 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-B.
 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Metal Floor Boxes:
1. Material: Cast metal or sheet metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, round.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches.
- K. Gangable boxes are allowed.
- L. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures:
 - a. Material: Fiberglass.
 - b. Finished inside with radio-frequency-resistant paint.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
1. NEMA 250, Type 3R, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.12 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

- A. General Requirements for Handholes and Boxes:
 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. Comply with TIA-569-B.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation; Hubbell Power Systems.
 - d. NewBasis.
 - e. Oldcastle Precast, Inc.; Christy Concrete Products.
 - f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
 3. Standard: Comply with SCTE 77.
 4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 7. Cover Legend: Molded lettering, "COMMUNICATIONS".
 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation; Hubbell Power Systems.
 - d. NewBasis.
 - e. Nordic Fiberglass, Inc.
 - f. Oldcastle Precast, Inc.; Christy Concrete Products.
 - g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
 3. Standard: Comply with SCTE 77.
 4. Color of Frame and Cover: Gray.
 5. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 6. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
8. Cover Legend: Molded lettering, "COMMUNICATIONS."
9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
10. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 2 EXECUTION

2.01 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed Conduit: RNC, Type EPC-40-PVC.
 2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: RNC, Type EPC-40-PVC.
 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT or RNC.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: IMC. Pathway locations
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT or innerduct.
 5. Damp or Wet Locations: IMC.
 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, communications-cable pathway.
 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, communications-cable pathway.
 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: Plenum-type, optical-fiber-cable pathway, [Plenum-type, communications-cable pathway.
 9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

2.02 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- M. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- O. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- P. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- Q. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 - 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 - 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

- R. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
 - S. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
 - T. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service pathway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
 - U. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
 - V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
 - W. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
 - X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 - Y. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
 - Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
 - AA. Set metal floor boxes level and flush with finished floor surface.
 - BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
 - CC. installed.
- 2.03 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

2.04 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

2.05 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Ladder cable trays.
 - 2. Wire-basket cable trays.
 - 3. Single-rail cable trays.
 - 4. Trough cable trays.
 - 5. Fiberglass cable trays.
- B. Related Requirements:
 - 1. Section 260536 "Cable Trays for Electrical Systems" for cable trays and accessories serving electrical systems.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Include cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - 2. Vertical and horizontal offsets and transitions.
 - 3. Clearances for access above and to side of cable trays.
 - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
 - 5. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 6. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- B. Field quality-control reports.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
 - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.02 LADDER CABLE TRAYS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 2. Chalfant Manufacturing Company.
 - 3. Cooper B-Line, Inc.
 - 4. Mono-Systems, Inc.
 - 5. MP Husky.
 - 6. Niedax-Kleinhuis USA, Inc.
- C. Description:
 - 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
 - 2. Rung Spacing 9 inches o.c.
 - 3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 - 4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
 - 5. No portion of the rungs shall protrude below the bottom plane of side rails.
 - 6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
 - 7. Minimum Usable Load Depth: 4 inches.
 - 8. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.
 - 9. Width: 12 inches unless otherwise indicated on Drawings.
 - 10. Fitting Minimum Radius: [12 inches.
 - 11. Class Designation: Comply with NEMA VE 1, Class 12B.
 - 12. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - 13. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316
 - 14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.03

WIRE-BASKET CABLE TRAYS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 2. Cablofil/Legrande.
 - 3. Chalfant Manufacturing Company.
 - 4. Cooper B-Line, Inc.
 - 5. Enduro Systems, Inc.
 - 6. Mono-Systems, Inc.
 - 7. MP Husky.
 - 8. Niedax-Kleinhuis USA, Inc.
 - 9. Snaketray.
 - 10. Wiremaid Products Division; Vutec Corporation.
- C. Description:
 - 1. Configuration: Wires are formed into a standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
 - 2. Materials: High-strength-steel longitudinal wires with no bends.
 - 3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
 - 4. Sizes:
 - a. Straight sections shall be furnished in standard 118-inch lengths.
 - b. Wire-Basket Depth: 1-inch usable loading depth by 12 inches wide.
 - c. Wire-Basket Depth: 2-inch usable loading depth by 8 inches wide.
 - d. Wire-Basket Depth: 4-inch usable loading depth by 24 inches wide.
 - e. Wire-Basket Depth: 6-inch usable loading depth by 24 inches wide.
 - 5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
 - 6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 - 7. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316

2.04

MATERIALS AND FINISHES

- A. Steel:
 - 1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33.
 - 2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
 - 3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
 - 4. Finish: Mill galvanized before fabrication.
 - a. Standard: Comply with ASTM A 653/A 653M, G90 (Z275).
 - b. Hardware: Chromium-zinc plated, ASTM F 1136.
 - 5. Finish: Electrogalvanized before fabrication.
 - a. Standard: Comply with ASTM B 633.
 - b. Hardware: Galvanized, ASTM B 633.
 - 6. Finish: Hot-dip galvanized after fabrication.
 - a. Standard: Comply with ASTM A 123/A 123M, Class B2.
 - b. Hardware: Chromium-zinc plated, ASTM F 1136.
 - 7. Finish: Epoxy-resin Powder-coat enamel paint.

- a. Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
 - b. Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
 - c. Epoxy-Resin Topcoat: Epoxy, cold-cured, gloss, MPI# 77.
 - d. Hardware: Chromium-zinc plated, ASTM F 1136.
 - 8. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
 - 9. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.
 - B. Aluminum:
 - 1. Materials: Alloy 6063-T6 according to ANSI H 35.1/H 35.1M for extruded components and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H 35.1/H 35.1M for fabricated parts.
 - 2. Hardware: Chromium-zinc-plated steel, ASTM F 1136.
 - 3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
 - C. Stainless Steel:
 - 1. Materials: Low-carbon, passivated, stainless steel, Type 304L or Type 316L, ASTM F 593 and ASTM F 594.
 - 2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
- 2.05 CABLE TRAY ACCESSORIES
- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
 - B. Covers: Solid type made of same materials and with same finishes as cable tray.
 - C. Barrier Strips: Same materials and finishes as for cable tray.
 - D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
- 2.06 WARNING SIGNS
- A. Lettering: 1-1/2-inch high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
 - B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."
- 2.07 SOURCE QUALITY CONTROL
- A. Testing: Test and inspect cable trays according to NEMA FG 1.
- PART 3 EXECUTION
- 3.01 CABLE TRAY INSTALLATION
- A. Install cable trays according to NEMA FG 1.
 - B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure and install seismic restraints.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Locate and install supports according to NEMA FG 1. Do not install more than one cable tray splice between supports.
- M. Support wire-basket cable trays with center support hangers.
- N. Support center support hangers for wire-basket trays with 1/4-inch diameter rods.
- O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- P. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1. Space connectors and set gaps according to applicable standard.
- Q. Make changes in direction and elevation using manufacturer's recommended fittings.
- R. Make cable tray connections using manufacturer's recommended fittings.
- S. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
- T. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- U. Install cable trays with enough workspace to permit access for installing cables.
- V. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

- W. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- X. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- Y. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.02 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.03 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.
- E. Tie MI cables down every 36 inches where required to provide a 2-hour fire rating and every 72 inches elsewhere.
- F. In existing construction, remove inactive or dead cables from cable trays.

3.04 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 7. Check for improperly sized or installed bonding jumpers.
 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

3.06 PROTECTION

- A. Protect installed cable trays and cables.
1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION

SECTION 27 05 44

SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

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

PART 2 PRODUCTS

2.01 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized-steel sheet.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.

- b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch).

2.02 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 3. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 4. Pressure Plates: Carbon steel.
 - 5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating.

2.03 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Presealed Systems.

2.04 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Grounding.
- B. Related Requirements:
 - 1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
 - 2. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
 - 3. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Seismic Qualification Certificates: For equipment frames from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 PRODUCTS

2.01 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.02 EQUIPMENT FRAMES

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. ADC.
 2. Belden Inc.
 3. Cooper B-Line.
 4. Emerson Network Power Connectivity Solutions.
 5. Hubbell Premise Wiring.
 6. Leviton Commercial Networks Division.
 7. Middle Atlantic Products, Inc.
 8. Ortronics, Inc.
 9. Panduit Corp.
 10. Siemon Co. (The).
 11. Tyco Electronics Corporation; AMP Products.
- C. General Frame Requirements:
 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch panel mounting.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- D. Floor-Mounted Racks: Modular-type, aluminum construction.
 1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
 2. Baked-polyester powder coat finish.

- E. Modular Freestanding Cabinets:
 - 1. Removable and lockable side panels.
 - 2. Hinged and lockable front and rear doors.
 - 3. Adjustable feet for leveling.
 - 4. Screened ventilation openings in the roof and rear door.
 - 5. Cable access provisions in the roof and base.
 - 6. Grounding bus bar.
 - 7. Rack-mounted, 550-cfm fan with filter.
 - 8. Power strip.
 - 9. Baked-polyester powder coat finish.
 - 10. All cabinets keyed alike.
- F. Modular Wall Cabinets:
 - 1. Wall mounting.
 - 2. Steel or aluminum construction.
 - 3. Treated to resist corrosion.
 - 4. Lockable front and rear doors.
 - 5. Louvered side panels.
 - 6. Cable access provisions top and bottom.
 - 7. Grounding lug.
 - 8. Rack-mounted, 250-cfm fan.
 - 9. Power strip.
 - 10. All cabinets keyed alike.
- G. Cable Management for Equipment Frames:
 - 1. Metal, with integral wire retaining fingers.
 - 2. Baked-polyester powder coat finish.
 - 3. Vertical cable management panels shall have front and rear channels, with covers.
 - 4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.03 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Rack mounting.
 - 3. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 - 4. LED indicator lights for power and protection status.
 - 5. LED indicator lights for reverse polarity and open outlet ground.
 - 6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 - 7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
 - 8. Close-coupled, direct plug-in line cord.
 - 9. Rocker-type on-off switch, illuminated when in on position.
 - 10. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
 - 11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.04 GROUNDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
 - 1. Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with J-STD-607-A.
- 2.05 LABELING
- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- PART 3 EXECUTION
- 3.01 ENTRANCE FACILITIES
- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for materials and installation requirements for underground pathways.
- 3.02 INSTALLATION
- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- 3.03 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.04 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.06 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
- B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration including optional identification requirements of this standard.
- D. Labels shall be preprinted or computer-printed type.

END OF SECTION

SECTION 27 13 00

COMMUNICATIONS BACKBONE CABLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. UTP cabling.
 - 2. 50/125 or 62.5/125-micrometer, optical fiber cabling.
 - 3. Coaxial cable.
 - 4. Multiuser telecommunications outlet assemblies.
 - 5. Cable connecting hardware, patch panels, and cross-connects.
 - 6. Telecommunications outlet/connectors.
 - 7. Cabling system identification products.
 - 8. Cable management system.
- B. Related Requirements:
 - 1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
 - 2. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
- C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.08 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. Patch-Panel Units: One of each type.
 - 2. Connecting Blocks: One of each type.
 - 3. Device Plates: One of each type.

4. Multiuser Telecommunications Outlet Assemblies: One of each type.

1.09 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
 3. Test each pair of UTP cable for open and short circuits.

PART 2 PRODUCTS

2.01 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.02 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 450 or less.
 - C. 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.
 - D. Grounding: Comply with J-STD-607-A.
- 2.03 BACKBOARDS
- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.
- 2.04 UTP CABLE
- 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:
 - B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. ADC.
 2. Belden Inc.
 3. Berk-Tek; a Nexans company.
 4. CommScope, Inc.
 5. Draka Cableteq USA.
 6. Genesis Cable Products; Honeywell International, Inc.
 7. Mohawk; a division of Belden Networking, Inc.
 8. Superior Essex Inc.
 9. SYSTIMAX Solutions; a CommScope, Inc. brand.
 10. 3M Communication Markets Division.
 11. Tyco Electronics Corporation; AMP Products.
 - C. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
 1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.
 - b. Communications, Plenum Rated: Type CMP complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX.
 - e. Multipurpose: Type MP or MPG.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.
- 2.05 UTP CABLE HARDWARE
- 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:
 - B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. ADC.
 2. American Technology Systems Industries, Inc.
 3. Belden Inc.
 4. Dynacom Inc.

5. Hubbell Premise Wiring.
 6. Leviton Commercial Networks Division.
 7. Molex Premise Networks; a division of Molex, Inc.
 8. Panduit Corp.
 9. Siemon Co. (The).
 10. Tyco Electronics Corporation; AMP Products.
- C. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- D. Connecting Blocks: 110-style IDC for Category. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- G. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- H. Patch Cords: Factory-made, four-pair cables in 36-inch 48-inch lengths; terminated with eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 2. Patch cords shall have color-coded boots for circuit identification.

2.06 OPTICAL FIBER CABLE

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Belden Inc.
 2. Berk-Tek; a Nexans company.
 3. CommScope, Inc.
 4. Corning Cable Systems.
 5. CSI Technologies Inc.
 6. General Cable Technologies Corporation.
 7. Mohawk; a division of Belden Networking, Inc.
 8. Superior Essex Inc.
 9. SYSTIMAX Solutions; a CommScope, Inc. brand.
 10. 3M Communication Markets Division.
 11. Tyco Electronics Corporation; AMP Products.
- C. Description: Multimode, 50/125 or 62.5/125-micrometer, 2, 4, or 6 -fiber, tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 3. Comply with TIA-492AAAB for detailed specifications.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

- a. General Purpose, Nonconductive: Type OFN or OFNG.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG.
 - e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
- 5. Conductive cable shall be aluminum armored type.
- 6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
- 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- D. Jacket:
 - 1. Jacket Color: Aqua for 50/125-micrometer cable and Orange for 62.5/125-micrometer cable.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.07 OPTICAL FIBER CABLE HARDWARE

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. ADC.
 - 2. American Technology Systems Industries, Inc.
 - 3. Belden Inc.
 - 4. Berk-Tek; a Nexans company.
 - 5. Corning Cable Systems.
 - 6. CSI Technologies Inc.
 - 7. Dynacom Inc.
 - 8. Hubbell Premise Wiring.
 - 9. Molex Premise Networks; a division of Molex, Inc.
 - 10. Siemon Co. (The).
- C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- D. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
- E. Cable Connecting Hardware:
 - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 - 2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
 - 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.08 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

- B. Workstation Outlets: Two or Four -port-connector assemblies mounted in single faceplate.
 - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 - 2. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
 - 3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
 - 4. Legend: Factory labeled by silk-screening or engraving for stainless steel.
 - 5. Legend: Machine printed, in the field, using adhesive-tape label.
 - 6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.09 GROUNDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.11 CABLE MANAGEMENT SYSTEM

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. iTRACS Corporation, Inc.
 - 2. TelSoft Solutions.
- C. Description: Computer-based cable management system, with integrated database and graphic capabilities.
- D. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
- E. Information shall be presented in database view, schematic plans, or technical drawings.
 - 1. AutoCAD drawing software shall be used as drawing and schematic plans software.
- F. System shall interface with the following testing and recording devices:
 - 1. Direct upload tests from circuit testing instrument into the personal computer.
 - 2. Direct download circuit labeling into labeling printer.

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.

- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

PART 3 EXECUTION

3.01 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.02 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
 - 3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 2. Install lacing bars and distribution spools.
 - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.03 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. MUTOA shall not be used as a cross-connect point.
 - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
 - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 12. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
1. Comply with BICSI TDM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.04 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.06 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 1. Administration Class: 3.
 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration, including optional identification requirements of this standard.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
 - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.07 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 test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 - 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 - 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
6. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
8. Coaxial Cable Tests: Conduct tests according to Section 274133 "Master Antenna Television System."
9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.08

DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION

SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

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. UTP cabling.
 - 2. 50/125 or 62.5/125-micrometer, optical fiber cabling.
 - 3. Coaxial cable.
 - 4. Multiuser telecommunications outlet assemblies.
 - 5. Cable connecting hardware, patch panels, and cross-connects.
 - 6. Telecommunications outlet/connectors.
 - 7. Cabling system identification products.
 - 8. Cable management system.
- B. Related Requirements:
 - 1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
- C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.8 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. Patch-Panel Units: One of each type.
 - 2. Connecting Blocks: One of each type.
 - 3. Device Plates: One of each type.
 - 4. Multiuser Telecommunications Outlet Assemblies: One of each type.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Test cables upon receipt at Project site.
1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
 3. Test each pair of UTP cable for open and short circuits.

PART 2 PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 450 or less.
- C. 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.

- D. Grounding: Comply with J-STD-607-A.

2.3 BACKBOARDS

2.4 UTP CABLE

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. ADC.
 2. Belden Inc.
 3. Berk-Tek; a Nexans company.
 4. CommScope, Inc.
 5. Draka Cableteq USA.
 6. Genesis Cable Products; Honeywell International, Inc.
 7. Mohawk; a division of Belden Networking, Inc.
 8. Superior Essex Inc.
 9. SYSTIMAX Solutions; a CommScope, Inc. brand.
 10. 3M Communication Markets Division.
 11. Tyco Electronics Corporation; AMP Products.
- C. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.
 - b. Communications, Plenum Rated: Type CMP complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX.
 - e. Multipurpose: Type MP or MPG.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.5 UTP CABLE HARDWARE

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. ADC.
 2. American Technology Systems Industries, Inc.
 3. Belden Inc.
 4. Dynacom Inc.
 5. Hubbell Premise Wiring.
 6. Leviton Commercial Networks Division.
 7. Molex Premise Networks; a division of Molex, Inc.
 8. Panduit Corp.
 9. Simon Co. (The).
 10. Tyco Electronics Corporation; AMP Products.

- C. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- D. Connecting Blocks: 110-style IDC for Category. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- G. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- H. Patch Cords: Factory-made, four-pair cables in 36-inch 48-inch lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.

2.6 OPTICAL FIBER CABLE

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Belden Inc.
 - 2. Berk-Tek; a Nexans company.
 - 3. CommScope, Inc.
 - 4. Corning Cable Systems.
 - 5. CSI Technologies Inc.
 - 6. General Cable Technologies Corporation.
 - 7. Mohawk; a division of Belden Networking, Inc.
 - 8. Superior Essex Inc.
 - 9. SYSTIMAX Solutions; a CommScope, Inc. brand.
 - 10. 3M Communication Markets Division.
 - 11. Tyco Electronics Corporation; AMP Products.
- C. Description: Multimode, 50/125 or 62.5/125-micrometer, 2, 4, or 6 -fiber, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 - 3. Comply with TIA-492AAAB for detailed specifications.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG.
 - e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
 - 5. Conductive cable shall be aluminum armored type.

6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- D. Jacket:
1. Jacket Color: Aqua for 50/125-micrometer cable and Orange for 62.5/125-micrometer cable.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.7 OPTICAL FIBER CABLE HARDWARE

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. ADC.
 2. American Technology Systems Industries, Inc.
 3. Belden Inc.
 4. Berk-Tek; a Nexans company.
 5. Corning Cable Systems.
 6. CSI Technologies Inc.
 7. Dynacom Inc.
 8. Hubbell Premise Wiring.
 9. Molex Premise Networks; a division of Molex, Inc.
 10. Siemon Co. (The).
- C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- D. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
- E. Cable Connecting Hardware:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.8 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Two or Four -port-connector assemblies mounted in single faceplate.
1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 2. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
 3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

- a. Flush mounting jacks, positioning the cord at a 45-degree angle.
- 4. Legend: Factory labeled by silk-screening or engraving for stainless steel.
- 5. Legend: Machine printed, in the field, using adhesive-tape label.
- 6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.9 GROUNDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.11 CABLE MANAGEMENT SYSTEM

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. iTRACS Corporation, Inc.
 - 2. TelSoft Solutions.
- C. Description: Computer-based cable management system, with integrated database and graphic capabilities.
- D. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
- E. Information shall be presented in database view, schematic plans, or technical drawings.
 - 1. AutoCAD drawing software shall be used as drawing and schematic plans software.
- F. System shall interface with the following testing and recording devices:
 - 1. Direct upload tests from circuit testing instrument into the personal computer.
 - 2. Direct download circuit labeling into labeling printer.

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
 - 3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 2. Install lacing bars and distribution spools.
 - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. MUTOA shall not be used as a cross-connect point.
 - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
 - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 12. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
- G. Group connecting hardware for cables into separate logical fields.
- H. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

- b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
- 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

- A. Comply with TIA-569-B, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Administration Class: 3.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration, including optional identification requirements of this standard.
- D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

- F. Cable and Wire Identification:
1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 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 test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:

- 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
6. UTP Performance Tests:
- a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
8. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
- a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- 3.8 DEMONSTRATION
- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION

COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 DATA AND VOIP OUTLETS

1.1 COMMSCOPE – ADC KRONE

Note: For those locations where the patch panel is installed in a cabinet or primary rack, the data outlets are not individually installed in the patch panel. Refer to Commscope – ADC Krone Part No. 6653 1 679-24 (24-Port Category 6 Patch Panel with Snap-in Port ID Tabs and Paper Labels, T568A/B Compatible) or 6653 1 679-48 (48-Port Category 6 Patch Panel with Snap-in Port ID Tabs and Paper Labels, T568A/B Compatible).

- A. Terminate each data outlet with one (1) black, Category 6, 8 position snap-in jack. Commscope – ADC Krone Part No. 6830 1 830-04.
- B. Terminate each Power-Over-Ethernet data / VoIP phone outlet with one (1) , Category 6, 8 position snap-in jack. Commscope – ADC Krone Part No. 6830 1 830-07.
- C. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Commscope – ADC Krone Part No. 6645 1 160-02.

PROVIDE QUANTITY OF: AS REQUIRED

1.2 SIEMON

Note: For those locations where the patch panel is installed in a cabinet or primary rack, the data outlets are not individually installed in the patch panel. Refer to Siemon Part No. HD6-24 (24-Port Panel, T568A/B wiring, 1RMS) or HD6-48 (48-Port Panel, T568A/B wiring, 2RMS)

- A. Terminate each data outlet installed in a faceplate with one (1) black, angled, Category 6, 8 position snap-in jack. Siemon Part No. MX6-01
- B. Terminate each data outlet installed in a patch panel with one (1) black, flat, Category 6, 8 position snap-in jack. Siemon Part no. MX6-F01.
- C. Terminate each Power Over Ethernet data/ VoIP phone outlet installed in a faceplate not mounted at +46" A.F.F. with one (1) , angled, Category 6, 8 position snap-in jack. Siemon Part No. MX6-07.
- D. Terminate each Power Over Ethernet data/VoIP phone outlet installed in a patch panel with one (1) , flat, Category 6, 8 position snap-in jack. Siemon Part No. MX6-F07.
- F. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Siemon Part No. MX-BL-20.

PROVIDE QUANTITY OF: AS REQUIRED

1.3 COMMSCOPE - SYSTIMAX

Note: For those locations where the patch panel is installed in a cabinet or primary rack, the data outlets are not individually installed in the patch panel. Refer to Commscope - Systimax Part No. 360-IPR-1100-E-GS3-1U-24 (760152561) or 360-IPR-1100-E-GS3-2U-48 (760152579).

- A. Terminate each data outlet installed in a faceplate with one (1) black, Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-003, 700206667 mounted in the angled position.
- B. Terminate each data outlet installed in a patch panel with one (1) black, Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-003, 700206667 mounted in the flat position.
- C. Terminate each Power-Over-Ethernet data / VoIP phone outlet installed in a faceplate not mounted at +46" A.F.F. with one (1) , Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-226 (700206709), mounted in the angled position. The only exception is for those outlets installed in flat faceplates on either DS4000 or 4000 series Wiremold raceway which is mounted horizontally on the wall (typically in computer labs). For those single gang faceplates mounted vertically on DS4000 (also a vertical run), the jacks shall be angled downward.
- D. Terminate each Power-Over-Ethernet data / VoIP phone outlet installed in a modular patch panel with one (1) , Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-226 (700206709), mounted in the flat position.
- E. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Commscope - Systimax Part No. M20AP-246, 107067860.

PROVIDE QUANTITY OF: AS REQUIRED

1.4 BLT BERK-TEK/LEVITON

Note: For those locations where the patch panel is installed in a cabinet or primary rack, the data outlets are not individually installed in the patch panel. Refer to BLT Leviton Part No. 69586-U24 (24-Port Category 6 Patch Panel with Drop-in Port ID Tabs and Paper Labels, T568A/B Compatible) or 69586-U48 -48 (48-Port Category 6 Patch Panel with Drop-in Port ID Tabs and Paper Labels, T568A/B Compatible).

- A. Terminate each data outlet with one (1) black, Category 6, 8 position snap-in jack. BLT Leviton Part No. 61110-RE6.
- B. Terminate each Power-Over-Ethernet data / VoIP phone outlet with one (1) , Category 6, 8 position snap-in jack. BLT Leviton Part No. 61110-RV6.
- C. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use BLT Leviton Part No. 41084-BIB.

PROVIDE QUANTITY OF: AS REQUIRED

PART 2 CAT6 SHIELDED OUTLETS – WIRELESS POE

2.1 COMMSCOPE – ADC KRONE

Commscope – ADC Krone does not have a product, and therefore requires the cable and connectivity from another Commscope cable manufacturer. Use Commscope – Systimax as a solution. Provide appropriate manufacturer faceplates and any associated materials at wireless outlet locations to match.

2.2 SIEMON

For locations where a 1U, 24 port modular CAT6 shielded patch panel is shown, the contractor shall provide patch panel Z6AS-PNL-24. The part number comes with all the CAT6 shielded jacks required to fully populate the patch panel.

- A. Install Siemon Part No. Z6A-S07 at locations designated for CAT6 wireless outlets identified in the drawings.

PROVIDE QUANTITY OF: AS REQUIRED

2.3 COMMSCOPE – SYSTIMAX

- A. Install Commscope – Systimax Part No. HGS620 (760152801) at locations designated for CAT6 wireless outlets identified in the drawings.
 - 1. Provide an M-series adapter for each faceplate location, Commscope - Systimax Part No. HGS-A- (760154237).
- B. Install Commscope – Systimax Part No. HGS620 (760152801) for each modular opening on the 24 port shielded patch panels Part No. 360-IPR-MFTP-E-HD6B-1U-24 identified in the drawings.

PROVIDE QUANTITY OF: AS REQUIRED

2.4 BLT – BERKTEK/LEVITON

BLT Berk-Tek: Not approved at this time. Contractor shall use one of the other three solutions provided. Contractor shall attain certification and provide 15 year warranty for installation. Provide appropriate manufacturer faceplates and any associated materials at wireless outlet locations to match.

PART 3 PHONE OUTLETS

3.1 COMMSCOPE – ADC KRONE

- A. Terminate each phone outlet with one (1) white, RJ-11 snap-in jack. Use Commscope – ADC Krone Part No. 6467 5 195-20.
 - 1. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Commscope – ADC Krone Part No. 6645 1 160-02.

PROVIDE QUANTITY OF: AS REQUIRED

3.2 SIEMON

- A. Terminate each phone outlet mounted at +18" A.F.F. with one (1) white, angled, RJ-11 snap-in jack. Use Siemon Part No. MX3-U3-02.
- B. Terminate each phone outlet mounted at +46" A.F.F. with one (1) white, flat, RJ-11 snap-in jack. Use Siemon Part No. MX3-F-U3-02.
- C. Terminate each Power-Over-Ethernet VoIP phone outlet mounted at +46" A.F.F. with one (1) , flat, Category 6 RJ-45 snap-in jack. Siemon Part No. MX6-F07.
- D. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Siemon Part No. MX-BL-20.

PROVIDE QUANTITY OF: AS REQUIRED

3.3 COMMSCOPE - SYSTIMAX

- A. Terminate each phone outlet mounted at +18" A.F.F. with one (1) white, RJ-11 snap-in jack, mounted in the angled position. Use Commscope - Systimax Part No. M1AH-262, 107322166.
- B. Terminate each phone outlet mounted at +46" A.F.F. with one (1) white, RJ-11 snap-in jack, mounted in the flat position. Use Commscope - Systimax Part No. M1AH-262, 107322166.

- C. Terminate each Power-Over-Ethernet VoIP phone outlet mounted at +46" A.F.F. with one Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-226, 700206709 mounted in the flat position.
- D. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Commscope - Systimax Part No. M20AP-246, 107067860.

PROVIDE QUANTITY OF: AS REQUIRED

3.4 BLT BERK-TEK/LEVITON

- A. Terminate each phone outlet with one (1) white, RJ-11 snap-in jack. Use BLT Leviton Part No. 41106-RW6.
- B. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use BLT Leviton Part No. 41084-BIB.

PROVIDE QUANTITY OF: AS REQUIRED

PART 4 FACEPLATES

4.1 GENERAL

- A. Provide each data outlet and +18" A.F.F. telephone outlet with an ivory, single-gang, four port, angled (downward) faceplate at each location not using the Wiremold 4000 series.
 - 1. Commscope – ADC Krone Part No. 6644 1 174-02
 - a. When installing plates in the Wiremold 4000 series, use appropriate Commscope – ADC Krone faceplate.
 - 2. Siemon Part No. MX-FP-S-04-20
 - a. When installing plates in the Wiremold 4000 series, use appropriate Siemon faceplate.
 - 3. Commscope - Systimax Part No. M14LE-246, 108333154.
 - a. When installing plates in the Wiremold 4000 series, use appropriate Commscope- Systimax faceplate.
 - 4. BLT Leviton Part No. 42081-4IP.
 - a. When installing plates in the Wiremold 4000 series, use appropriate BLT Leviton faceplate.

PROVIDE QUANTITY OF: AS REQUIRED

4.2 WALL MOUNT PHONES

- A. Provide each telephone outlet designated as a wall mount location with an ivory, single-gang, two port, flush/flat faceplate.
 - 1. Commscope – ADC Krone Part No. 6644 1 152-02.
 - 2. Siemon Part No. MX-FP-S-02-20.
 - 3. Commscope - Systimax Part No. M12LE-246, 108333055.
 - 4. BLT Leviton Part No. 42080-2IS.

PROVIDE QUANTITY OF: AS REQUIRED

4.3 MULTI USE CEILING ENCLOSURES

- A. Provide each data outlet, fiber snap-in jack and/or audio/video control and distribution cable outlet installed in a Multi-Use Ceiling Enclosure with an ivory, double-gang, twelve port, flush faceplate.
 - 1. Commscope – ADC Krone Part No. 6644 1 157-02.
 - 2. Siemon Part No. MX-FP-D-12-20.
 - 3. Commscope - Systimax Part No. M26FP-246, 760008615.
 - 4. BLT Leviton Part No. 42080-12I.

PROVIDE QUANTITY OF: AS REQUIRED

- B. Provide double outlet adapters for all six (6) adaptor positions in the flexible faceplate to accommodate copper and optical fiber cabling snap-in jacks.
 - 1. Commscope - Systimax Part No. M30FP-2RJ45-246, 760008656.
PROVIDE QUANTITY OF: AS REQUIRED

4.4 SURFACE MOUNT CAT6 WIRELESS BOXES

- A. Provide a 2 port ivory surface outlet box on the surface of wall locations where identified in the drawings. Use Wiremold V2400 series raceway directly down from the accessible ceiling space to the outlet box at +96" AFF. Jacks shall always face downward.
 - 1. Commscope – Systimax Part No. M202SMB-246 (760057356).
 - 2. Siemon Part No. MX-SMZ2-20.
PROVIDE QUANTITY OF: AS REQUIRED

4.5 WIRELESS OUTLET FACEPLATE

- A. The CAT6 Shielded wireless junction boxes, if not using surface mount boxes, shall be installed in acoustical tile ceilings or in walls at +96" AFF. These locations will be using the 5-square Telecom junction box with 2-gang mud ring. These locations require a 2-gang faceplate, using two holes for the wireless. The jacks/faceplate shall be angled (downward if on wall). The Contractor shall submit, as part of their product submittal, the faceplate which they intend to use. The faceplate shall be from the manufacturer of the approved CAT6 Shielded manufacturer they intend to use on the project. The faceplate can be multiport, provided blanks are the same color of the faceplate are inserted in unused ports.
 - 1. For ceiling faceplates, the color of the angled, 2-gang faceplate shall be colored white.
 - 2. For wall mounted faceplates, the color of the angled, 2-gang faceplate shall be colored ivory.
PROVIDE QUANTITY OF: AS REQUIRED

PART 5 MULTI MODE OPTICAL FIBER CABLE TERMINATIONS

5.1 OM3 / OM4 LC CONNECTORS

- A. Terminate all multimode fiber optic cables as required with an LC connector. Land the LC connectors in the fiber interconnect center LC adapter plate as shown in the detail drawings. All fiber optic LC connectors shall be capable of achieving an insertion loss of .30 dB or less which is guaranteed under the warranty (using a contractor certified with the manufacturer) provided by the following manufacturers. The lower loss is necessary to meet the performance link loss / insertion loss requirements identified in Specification Section 27 13 00.
 - 1. Commscope – ADC Krone Part No. FILC-M5UMM-30.
 - 2. Siemon Part No. FC1-LC-MM-B80.
 - 3. Commscope - Systimax Part No. 760117887 (MFC-LCF-09-5X) Qwik II-LC.
 - 4. Leviton Part No. 49991-LLC.
PROVIDE QUANTITY OF: AS REQUIRED

PART 6 WIRELESS OUTLET PATCH CORDS

6.1 CONTRACTOR PROVIDED, OWNER INSTALLED PATCH CORDS

- A. In order to avoid impedance mismatches by mixing patch cords from different manufacturers, the contractor shall provide the CAT6 shielded patch cords to the Owner prior to the submittal of test reports. The Contractor shall provide Quantity 12 each of the following patch cords for each 24 port CAT6 patch panel shown in the drawings, regardless of how many outlets are being terminated. Provide twelve 3 foot long and twelve 4 foot long white patch cords for each CAT6 shielded patch panel shown. Patch Cords shall match manufacturer of cable and outlets installed.

1. Siemon Part No. ZM6A-S03-02 (CAT6 Shielded White 3FT)
2. Siemon Part No. ZM6A-S04-02 (CAT6 Shielded White 4FT)
3. Commscope – Systimax Part No. CPCGG32-08F003 (G10FP-WH-3FT)
4. Commscope – Systimax Part No. CPCGG32-08F004 (G10FP-WH-4FT)

PART 7 WIRELESS OUTLET (SPECIAL CONDITIONS)

7.1 WIRELESS ACCESS POINT ENCLOSURE FOR GYMS

- A. For those CAT6 Wireless outlets installed at +96" AFF in a Gym, the Contractor shall install a protective enclosure next to the outlet in order to protect the Access Point (AP) which will be installed by the Owner. The bottom of the enclosure shall be in-line with the bottom of the Wireless outlet faceplate or surface outlet box. Place enclosure approximately 6 inches away from the edge of the faceplate or surface outlet box, upright (door swings to side), and drill a one inch (1") hole in the bottom of the enclosure. Drilled hole shall be located close to edge nearest the outlet and two inches (2") from back of enclosure. Contractor shall also install back panel inside enclosure so Owner can mount a Wireless Access Point inside. Coordinate locations prior to installation to be certain bot outlet and enclosure can fit in the designated location. Take care to avoid any murals, conduit, or acoustical dampening panels. Use the following parts:

1. Enclosure with clear cover, 17.65"H x 16.68"W x 9.98"D. Use Stahlin Polystar series enclosure Part Number PC1614CC.
2. Rear mounting back panel. Use Stahlin Polystar series panel Part Number BP1614.

PROVIDE QUANTITY OF: AS REQUIRED

7.2 ACCESS POINT MOUNT FOR PLASTER, CMU, OR POURED CONCRETE (TILT-UP) WALLS

- A. When a wireless outlet is installed on a plaster, CMU, or poured concrete (tilt-up) wall, the Contractor shall install an 8 inch x 8 inch (8" x 8") piece of ¾" backboard. Paint backboard to match background colors.

1. Contractor shall coordinate with UNLV, and the Engineer in writing regarding requirement to establish if there are any conflicts with materials and if there is a preferred alternate which should be used.

PROVIDE QUANTITY OF: AS REQUIRED

END OF SECTION

FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, fully functional, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), Auxiliary Control Devices including Remote Testing Units, Annunciators, Radio Alarm Transmitter, and wiring as specified herein.
- B. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- C. The installing company shall employ NICET (minimum Level II certification in fire protection engineering technology, sub field of fire alarm systems) technician to review and sign off on shop drawings and to be on Site to guide the final checkout and to ensure system integrity.

1.2 SCOPE

- A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.
- B. Basic Performance:
 - 1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
 - 2. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
 - 3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
 - 4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 - 5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

C. Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

- 1. The system alarm on the system display shall flash.
- 2. A local electric signal in the FACP and Annunciator Panel shall sound.
- 3. A lighted display shall indicate all information associated with the alarm condition, including the type of alarm point and its location within the protected premises.
- 4. Event history storage equipment shall log the information associated each new alarm control panel condition, along with time and date of occurrence.
- 5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

1.3 SUBMITTALS

- A. General:
1. Submittals shall be reviewed by the Engineer prior to submitting them to the AHJ (authority having jurisdiction).
 2. Three (3) copies of complete submittals for all equipment and devices, as specified, shall be submitted to the Owner for review and approval not later than seven (7) calendar days after notification of Intent to Award.
 3. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-Listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
 4. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.
- B. Shop Drawings.
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications and current adopted code of the AHJ.
 2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
 3. Show annunciator layout, configurations, and terminations.
- C. Manuals:
1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
 2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
 3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.
- D. Software Modifications
1. Provide the services of a manufacturer trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
 2. Provide all hardware, software, programming tools and documentation necessary to modify the system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

E. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4 GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance by the AHJ. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.5. POST CONTRACT MAINTENANCE AND TESTING:

- A. All maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of two (2) years after acceptance by the AHJ.
- B. Provide all maintenance, tests, and repairs described below for two (2) years from date of acceptance by AHJA The full cost of maintenance, testing, labor and materials during this two year period shall be included in the submittal bid.
- C. Maintenance and testing shall be on a quarterly basis with approximately one quarter of the devices serviced/tested during each quarterly inspection. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:
 - 1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow and tamper switches and all accessories of the fire alarm system.
 - 2. Each circuit in the fire alarm system shall be tested semiannually.
 - 3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

1.6 POST CONTRACT EXPANSIONS: - NOT REQUIRED

1.7 APPLICABLE STANDARDS AND SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

- A. National Fire Protection Association (NFPA) - USA:
 - No. 13 Sprinkler Systems
 - No. 15 Water Spray Systems
 - No. 72 National Fire Alarm Code
 - No. 101 Life Safety Code
- B. Local and State Building Codes.
- C. All requirements of the Authority Having Jurisdiction (AHJ).

1.8 APPROVALS:

- A. The system shall have proper listing and/or approval from the following nationally recognized agencies:
 - UL Underwriters Laboratories Inc
 - ULC Underwriters Laboratories Canada
- A. The fire alarm control panel shall meet UL Standard 864 (Control Units).

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL:

- A. All equipment and components provided shall be "open source" and available from multiple independent, competitive dealers.

- B. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code. All batteries shall be installed within 90 days of manufacture date.
- C. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- D. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT AND CABLE AND WIRE:

- A. Conduit:
 - 1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
 - 2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
 - 3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-55.
 - 4. Wiring for 24-volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
 - 5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
 - 6. Conduit shall be 3/4-inch (19.1 mm) minimum.
- B. Cable and Wire:
 - 1. All alarm system cable and wiring shall be new.
 - 2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
 - 3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
 - 4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g. FPLR).
 - 5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
 - 6. All field wiring shall be electrically supervised for open circuit and ground fault.
 - 7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.
- C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

- D. Initiating circuits shall be arranged to serve like categories (manual, smoke, water flow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.
- E. The Fire Alarm Control Panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold-water pipe or grounding rod.

2.3 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

- A. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and/or thermal (heat) detectors, addressable modules, annunciators, and other system controlled devices.
- B. Operator Control
 - 1. Acknowledge Switch:
 - a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the display to the next alarm or trouble condition.
 - b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
 - 2. Alarm Silence Switch:

Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.
 - 3. Alarm Activate (Drill) Switch:

The Alarm Activate switch shall activate all notification appliance circuits only. The drill function shall latch until the panel is silenced or reset.
 - 4. System Reset Switch:

Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones: as well as all associated output devices and circuits, to return to their normal condition.
 - 5. Lamp Test:

The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display.
- C. System Capacity and General Operation
 - 1. The control panel or each network node shall provide, or be capable of expansion to a minimum of 400 intelligent/addressable devices.
 - 2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC.
 - 3. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits.
 - 4. The Notification Appliance Circuits shall be programmable to synchronize with applicable appliances.
 - 5. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color

- coded system status LEDs, and an alphanumeric keypad with easy touch keys for the field programming and control of the fire alarm system.
6. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
 7. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a computer are not considered suitable substitutes. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming.
 8. The FACP or each network node shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out
 - b. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.
 - c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
 - d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .03 percent per foot to 1 .0 percent per foot. The system shall also include up to nine levels of Pre-alarm, selected by detector, to indicate impending alarms to maintenance personnel.
 - e. The ability to display and print system reports.
 - f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
 - g. PAS pre-signal, meeting NFPA 72 3-8.3 requirements.
 - h. PAS pre-signal, meeting NFPA 72 3-8.4 requirements.
 - i. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 Chapter 1 requirements for activation of notification circuits within 10 seconds of initiating device activation.
 - j. Periodic detector test, conducted automatically by the software.
 - k. Self-optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular-environment and set its pre-alarm level to just above normal peaks.
 - l. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
 - m. Walk test) with a check for two detectors set to same address.
 - n. Control-by-time for non-fire operations, with holiday schedules.
 - o. Day/night automatic adjustment of detector sensitivity.
 9. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), and Temporal (NFPA 72 A-2-2 "). Panel notification circuits (NAC 1 1213 and 4) shall also support Two-Stage operationTwo stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian Dual stage is the same as Two-Stage except will only switch to second stage by activation of Drill Switch 3 or 5 minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."
 10. Network Communication
 - a. The FACP shall be capable of communicating on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol.

D. Central Microprocessor

1. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage! Flash memory for building-specific program storage, and a timer circuit to detect and report microprocessor failure.

2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
4. A special program check function shall be provided to detect common operator errors.
5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.

E. System Display

1. The display shall provide all the controls and indicators used by the system operator:

The display (80 or 640-character) shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill)| SYSTEM RESET, and LAMP TEST.
2. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
3. The display shall provide Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PRE-ALARM WARNING, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, ALARM SILENCED, Controls Active, Pre-Discharge, Discharge and Abort.
4. The display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
5. The system shall support the display of battery charging current and voltage.

F. Signaling Line Circuits (SLC)

1. Each FACP or FACP network node shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
2. CPU shall receive information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

- G. Serial Interfaces
1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (IT E) peripherals.
 - a. One EIA-232 interface shall be used to connect an UL-Listed 40 or 80 column printer. Printers that are not UL-Listed are not considered acceptable substitutes.
 - b. One EIA-232 interface shall be used to connect a UL-listed CRT terminal. This interface shall include special protocol methods that allow off-site monitoring of the FACP over standard dial-up phone lines. This ancillary capability shall allow remote readout of all status information, including analog values, and shall not interfere with or degrade FACP operations when used. It shall allow remote FACP Acknowledge, Reset, or Signal Silence in this mode. It shall also allow adjustment of detector sensitivity and readout of the history file.
 - c. The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.
 - d. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.
- I. Enclosures:
1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
 2. The back box and door shall be constructed with provisions for electrical conduit connections into the sides and top.
 3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.
- J. Power Supply:
1. An off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
 2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
 3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 55 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
 4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
Ground Fault LED
AC Power Fail LED
NAC on LED (4)
 5. The main power supply shall operate on 120 VAC 60 Hz, and shall provide all necessary power for the FACP.
 6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 200 AH.
 7. All circuits shall be power-limited, per UL864 requirements.
- K. Auxiliary Field Power Supply - Addressable
1. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.
 2. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz. All circuits shall be power-limited per UL 864 requirements.
 3. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional

synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.

4. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means,
5. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
6. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of eight or sixteen hours shall be Dipswitch selected.
7. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.
8. Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
9. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class 'IA' or by the use of an end-of-line resistor. When the power supply's output circuit is selected as General 24VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
10. When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal.
11. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
12. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
13. All individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

L. Field Charging Power Supply (FCPS)

The FCPS is designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

1. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 70 amp hour batteries and to support 60 hour standby.
2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
3. The FCPS shall include an attractive surface mount backbox.
4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.

M. Specific System Operations

1. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.

4. Point Read: The system shall be able to display or print the following point status diagnostic functions:
 - a. Device status
 - b. Device type
 - c. Custom device label
 - d. View analog detector values e, Device zone assignments
 - e. All program parameters
5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory, Systems that use volatile memory for history storage are not acceptable substitutes.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
 - a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
 - b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
 - c. All devices tested in walk test shall be recorded in the history buffer.
11. Water flow Operation:

An alarm from a water flow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.
12. Supervisory Operation:

An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.
13. Signal Silence Operation:

The FACP shall have the ability to program each output circuit (notification, relay, speaker etc.) to deactivate upon depression of the signal silence switch.
14. Non-Alarm Input Operation

Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

15. Combo Zone

A special type code shall be available to allow water flow and supervisory devices to share a common addressable module. Water flow devices shall be wired in parallel, supervisory devices in series.

2.4 SYSTEM COMPONENTS:

- A. Strobe lights shall meet the requirements of the ADA, UL Standard 1 971 1 be fully synchronized, and shall meet the following criteria:
 - 1. The maximum pulse duration shall be 2/1 0 of one second.
 - 2. Strobe intensity shall meet the requirements of UL 1971.
 - 3. The flash rate shall meet the requirements of UL 1971.
- B. Manual Fire Alarm Station(s)
 - 1. Manual fire alarm stations shall be non-code, non-break glass type, equipped with key lock so that they may be tested without operating the handle.
 - 2. Stations must be designed such that after an actual activation, they cannot be restored to normal except by key reset.
 - 3. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of 1 00 feet (30.5 m) front or side.
- C. Conventional Photoelectric Area Smoke Detectors
 - 1. Photoelectric smoke detectors shall be e 24 VDC, two wire, ceiling-mounted, light scattering type using an LED light source.
 - 2. Each detector shall contain a remote LED output and a built-in test switch.
 - 3. Detector shall be provided on a twist-lock base.
 - 4. It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.
 - 5. A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall flash at least every 10 seconds, indicating that power is applied to the detector.
 - 6. The detector shall not go into alarm when exposed to air velocities of up to 3000 feet (914,4 m) per minute.
 - 7. The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
 - 8. All field wire connections shall be made to the base through the use of a clamping plate and screw.
- D. Conventional Ionization Type Area Smoke Detectors
 - 1. Ionization type smoke detectors shall be a two wire, 24 VDC type using a dual unipolar chamber.
 - 2. Each detector shall contain a remote LED output and a built-in test switch.
 - 3. Detector shall be provided on a twist-lock base.
 - 4. It shall be possible to perform a calibration sensitivity and performance test on the detector without the need for the generation of smoke.
 - 5. A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs) over 360 degrees, on the detector, which may be seen from ground level. This LED shall flash every 10 seconds, indicating that power is applied to the detector.
 - 6. The detector shall not alarm when exposed to air velocities of up to 1 ,200 feet (365.76 m) per minute. The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
 - 7. All field wire connections shall be made to the base through the use of a clamping plate and screw.

E. Duct Smoke Detectors

Duct smoke detectors shall be a 24 VDC type with visual alarm and power indicators, and a reset switch. Each detector shall be installed upon the composite supply/return air ducts(s), with properly sized air sampling tubes. Install duct detector remote test stations for all duct detectors at readily accessible heights inside.

F. Automatic Conventional Heat Detectors

1. Automatic heat detectors shall have a combination rate of rise and fixed temperature rated at 135 degrees Fahrenheit (57.2 Celsius) for areas where ambient temperatures do not exceed 100 degrees (37.7 Celsius), and 200 degrees (93.33 Celsius) for areas where the temperature does not exceed 150 degrees (65.5 Celsius).
2. Automatic heat detectors shall be a low profile, ceiling mount type with positive indication of activation.
3. The rate of rise element shall consist of an air chamber, a flexible metal diaphragm, and a factory calibrated, moisture-proof, trouble free vent, and shall operate when the rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.
4. The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft.
5. Automatic heat detectors shall have a smooth ceiling rating of 2500 square feet (762 square meters).

G. Water flow Indicator:

1. Water flow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
2. Water flow Switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds, Initial settings shall be 30-45 seconds.
3. Water flow switches shall be provided and connected under this section but installed by the mechanical contractor.
4. Where possible, locate water flow switches a minimum of one (1) foot from a fitting which changes the direction of the flow and a minimum of three (3) feet from a valve.

H. Sprinkler and Standpipe Valve Supervisory Switches:

1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
4. The supervisory switch shall be contained in a weatherproof housing, which shall provide a 3/4 inch (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The switch housing shall be finished in red baked enamel.
6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.
7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.
 - a. This unit shall provide for each zone: alarm indications, using a red alarm and yellow trouble long-life LEDs and control switches for the control of fire alarm control panel functions. The annunciator will also have an ON-LINE LED, local piezo electric signal, local acknowledge/lamp test switch, and custom slide-in zone/function identification labels.

- b. Switches shall be available for remote annunciation and control of output points in the system, system acknowledge, telephone zone select, speaker select, global signal silence, and global system reset within the confines of all applicable standards.
- I. Alphanumeric LCD Type Annunciator:
 - 1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
 - 2. The LCD annunciator shall display all alarm and trouble conditions in the system.
 - 3. An audible indication of alarm shall be integral to the alphanumeric display.
 - 4. The display shall be UL listed for fire alarm application.
 - 5. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.
 - 6. The system shall allow the following system functions: Acknowledge, Signal Silence and Reset, which shall be protected from unauthorized use by a key switch or password.
 - 7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.
- J. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.
- K. Radio Alarm Transmitter:
 - 1. Transmitter shall comply with NFPA 1221 and shall be listed and labeled by an NRTL.
 - 2. Comply with 47 CFR 90,
 - 3. Description: Manufacturer's standard commercial product; factory assembled, wired, tested, and ready for installation and operation.
 - a. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
 - b. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
 - c. Normal Power Input 120-V ac.
 - d. Secondary Power: Integral-sealed, rechargeable 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
 - e. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware supports shall withstand 100 mph with a gust factor of 1.3 without failure.
 - f. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
 - g. Antenna-Cable Connectors: Weatherproof.
 - h. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
 - 4. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal being transmitted and shall include separately designated messages in response to the following events or conditions.
 - a. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
 - b. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.

- c. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
- d. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
- e. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
- f. Local Fire-Alarm-System Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.

L. Field Wiring Terminal Blocks

For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

M. Video Display Terminal

- 1. The Video Display Terminal shall provide a visual display and an audible alert of all changes in status of the system and shall annotate such displays with the current time-of-day and date.
- 2. The Video Display Terminal shall be enclosed in a cabinet suitable for placement on a desktop or table.
- 3. A detachable keyboard shall be provided that may be used for programming, testing, and control of the system. Individual keys shall be provided on the keyboard for the ACKNOWLEDGE, RESET, LAMP TEST, SYSTEM TEST, and SIGNAL SILENCE functions of the control panel.
- 4. The video display terminal shall include a count of all alarms and troubles in the system, as well as a count of all alarms and trouble requiring acknowledgment. These counts shall be continuously displayed during all FACP operations.

2.5 SYSTEM COMPONENTS ADDRESSABLE DEVICES

A. Addressable Devices - General

- 1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
- 2. Addressable devices, which use a binary-coded address setting method, such as a DIP switch, are not an allowable substitute.
- 3. Detectors shall be intelligent (analog) and addressable, and shall be connect with two wires to the fire alarm control panel Signaling Line Circuits.
- 4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
- 5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
- 6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
- 7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Bases shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.

8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
 9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
 10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
 11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
 12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
 13. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.
- B. Addressable Manual Fire Alarm Box (manual station)
1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
 2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
 3. Manual fire alarm boxes shall have clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.
- C. Intelligent Photoelectric Smoke Detector
1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
- D. Intelligent Laser Photo Smoke Detector
1. The intelligent laser photo smoke detector shall be a spot type detector that incorporates an extremely bright laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.
 2. The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.
 3. The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.03 percent per foot.
 4. The laser detector shall not require expensive conduit, special fittings or PVC pipe.
 5. The intelligent laser photo detector shall support standard, relay, isolator and sounder detector bases.
 6. The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.
 7. The laser photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.
- E. Intelligent Ionization Smoke Detector
1. The detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

- F. Intelligent Multi-Criteria Acclimating Detector
1. The intelligent multi criteria Acclimate detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.
 2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
 3. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.
- G. Intelligent Thermal Detectors
1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 1 5 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.
- H. Intelligent Duct Smoke Detector
1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, that provides continuous analog monitoring and alarm verification from the panel.
 2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.
- I. Hostile-Area Smoke Detector
1. The detector shall be designed to provide early warning smoke detection in environments where traditional smoke detectors are not practical,
 2. The detector shall have a filter system to remove particles down to 25 microns.
 3. This filter system shall remove unwanted airborne particles and water mist. This shall allow the detector to operate in environments where traditional smoke detectors would have nuisance alarms.
 4. The filter system shall consist of 2 filters one of which is field replaceable.
 5. The filter system shall have an intake fan to draw air and smoke through the filters into the sensing chamber.
 6. The filter system shall be supervised so that if the filter is clogged or the fan fails the control panel reports trouble.
 7. The filter system shall be powered from 24 VDC separate from the SLC communications.
 8. The detector shall utilize a photoelectric sensing chamber.
- J. Addressable Dry Contact Monitor Module
1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
 2. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
 3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

- K. Two Wire Detector Monitor Module
 - 1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device),
 - 2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

- L. Addressable Control Module
 - 1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
 - 2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive AA/ signal, or 2 amps of resistive AN signal operation.
 - 3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.
 - 4. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

- M. Addressable Relay Module
 - 1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1 .0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

- N. Isolator Module
 - 1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
 - 2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
 - 3. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
 - 4. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

- O. Smoke Control Annunciator
 - 1. On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan, To ensure compliance the units supplied shall meet the following UL categories : I-JUKL, PAZX, UDTZ, QVAX as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke Control, The control System shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.
 - 2. The OFF LED shall be Yellow, the ON LED shall be green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDS and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.
 - 3. Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators

shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable,

4. All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.
5. It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic.

2.6 BATTERIES:

- A. Batteries shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
- B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills) and leakage shall not be required,
- C. If necessary to meet standby requirements, external battery and charger systems may be used.
- D. All batteries to be installed within 90 days of the manufacture date,

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1 067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2 TEST:

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

- A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- C. Verify activation of all water flow switches.
- D. Open initiating device circuits and verify that the trouble signal actuates.
- E. Open and short signaling line circuits and verify that the trouble signal actuates.
- F. Open and short notification appliance circuits and verify that trouble signal actuates.

- G. Ground all circuits and verify response of trouble signals.
- H. Check presence and audibility of tone at all alarm notification devices.
- I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
- J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3 FINAL INSPECTION:

- A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4 INSTRUCTION:

- A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION

DETENTION MONITORING AND CONTROL 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 detention monitoring and control operating system, based on PLC technology with [hard-control] [hard-control panel and touchscreen video-control] [touchscreen video-control] panel operator interface.

1.3 DEFINITIONS

- A. I/O: Input/output.
- B. LAN: Local Area Network.
- C. LED: Light-emitting diode.
- D. Monitoring: Acquisition, processing, communication, and display of system and equipment status data and event and alarm signals.
- E. MOV: Metal-oxide varistor.
- F. Nonsecure: Closed and locked and with no unlock or open commands pending. (For doors and gates.)
- G. PLC: Programmable logic controller.
- H. Secure: Unlocked or open. (For doors and gates.)
- I. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.
- J. Zone: A space or area defined on Drawings for a specific purpose.

1.4 ACTION SUBMITTALS

- A. Product Data: For components for detention monitoring and control and systems integration. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
 - 1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
 - 2. Control Panel Layout: At full scale, show required artwork and device identification.

3. Wiring Diagrams: Detail specific power, control, signal, communication, and data wiring and cabling. Coordinate nomenclature and presentation with block diagram.
 4. Raceway Riser Diagrams: Detail raceway runs required for detention monitoring and control and for systems integration. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.
- C. Samples for Initial Color Selection: For control panel graphics and for equipment with factory-applied color finishes.
- D. Samples for Color Verification: For each control panel graphic and for each type of exposed finish required for equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:
1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections.
 - a. Indicate methods used to achieve systems integration.
 - b. Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
 - c. Describe characteristics of network and other data communication lines.
 - d. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.
 2. Touchscreen Audible Tones and Visual Indications: Include the following material for use at touchscreen video control panels:
 - a. Audible indication, notification, and alarm tones[and voice prompts].
 - b. Visual materials for touchscreen video control panel display screens, complete with proposed shapes, colors, scale, and textual content, including the following:
 - 1) Graphics, including maps.
 - 2) Icons.
 - 3) Dialog boxes.
 - 4) Help messages, prompts, and instructions.
 3. Submittal Media: CD-ROM[with color printout of graphic and textual material].
- B. Seismic Qualification Data: Submit certification that fabrication for completed equipment rack and control panel assemblies will withstand seismic forces defined in Section 270548.16 "Seismic Controls for Communications Systems." Include the following:
1. Description of features included in equipment and equipment assemblies to withstand anticipated acceleration loads.
 2. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

3. Dimensioned Outline Drawings of Equipment Racks and Control Panels: Identify center of gravity of fully equipped and assembled units and locate and describe mounting and anchorage provisions.
 4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Qualification Data: For [Installer] [Detention Electronic Systems Integrator].
 - D. Field quality-control reports.
 - E. Program documentation, software licenses, and backup copies of software used on Project.
 - F. Other Information Submittals:
 1. Examination reports documenting inspections of substrates, areas, and conditions.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For detention monitoring and control equipment components to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: A quantity equal to [10] <Insert number> percent of each type and rating indicated, but no fewer than 1 of each.
 2. Fuse Blocks: [Four] <Insert number> of each type used.
 3. Power Supplies: [One] <Insert number> of each type installed.
 4. Network Interface Cards: [One] <Insert number> of each type installed.
 5. Relay Modules: [Two] <Insert number> of each type used.
 6. Wire and Cable Terminals: [Five] <Insert number> of each type and size used.
 7. PLCs: [One] <Insert number> of each type and configuration used.
 8. PLC I/O Modules: [One] <Insert number> of each type and configuration used.
 9. PLC EPROMs: [One] <Insert number> completely programmed module for each program used.
 10. I/O Modules: [One] <Insert number> for every 10 of each type installed.
 11. Working Surface Overlays for Hard Control Panels: [Two] <Insert number> for each panel, laminated with [magnetic] [peel-off] material that facilitates mounting and removal, and complete with factory-applied graphics[and punching]. [Spare overlays shall be stored in safekeeping in manufacturer's facilities.]
 12. Control Panel Switches and LEDs: A quantity equal to [10] <Insert number> percent of each type and color installed.
 13. Complete Touchscreen Video Control Panel: [One] <Insert number>.
 14. Security Fasteners: Furnish not less than [1 box for every 50] <Insert quantities> boxes or fraction thereof, of each type and size of security fasteners installed.
- B. Tool Kit: Furnish [six] sets of tools for use with security fasteners, each packaged in a kit for easy handling and storage.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by detention door control manufacturer and detention monitoring and control equipment manufacturer and

with detention facility construction and systems integration experience with the following electronic systems:

1. Perimeter security.
2. Fire alarm.
3. Intercommunications.
4. Paging.
5. Remote lighting and power controls.
6. Video surveillance.

- B. Detention Electronic Systems Integrator Qualifications: A qualified detention electronics systems installer who has completed detention electronic systems integration work for installations similar in material, design, and extent to that indicated for Project, and whose work has resulted in construction with a record of successful in-service performance.
1. Experience: Full detention electronic systems integration responsibility for no fewer than [10] <Insert number> detention facility projects (jails or prisons) that have been completed and in operation for a minimum of [5] <Insert number> years.[At least one of the projects shall include pneumatic locks and door operators.]
 2. Experience: Detention Electronic Systems Integrator shall employ personnel that have documented experience exercising full responsibility for overall systems integration for the types of detention monitoring and control systems indicated for this Project and for facilities similar in scope to this Project.
- C. 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.

1.9 SERVICE CONDITIONS

- A. Environmental Service Conditions: Systems, equipment, and components shall be capable of operating continuously in the following conditions without mechanical or electrical damage or degradation of operating capability:
1. Ambient Temperature: 140 deg F (60 deg C).
 2. Relative Humidity: 10 to 95 percent, noncondensing.
- B. Electrical Service Conditions: Equipment shall operate continuously in the following conditions without damage or degradation of operating capability:
1. Voltage Range for Equipment with a Nominal Rating of 120-V AC: 88 to 132 V.
 2. Voltage Range for Equipment with a Nominal Rating of 24-V DC: 22 to 85 V.
 3. Frequency Range for Equipment with a Nominal Frequency Rating of 60 Hz: 45 to 63 Hz.

1.10 COORDINATION

- A. Coordinate Work of this Section with that of Sections specifying systems and components required to be integrated with detention monitoring and control equipment.
- B. Coordinate features of detention monitoring and control components with those of related detention electronic systems.
1. Provide integrated interconnections of compatible components.
 2. Match components and interconnections for optimum performance of indicated functions.

1.11 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide <Insert number> months' full maintenance by skilled employees of Detention Electronic Systems Integrator or Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper detention monitoring and control system operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment and components.

PART 2 - PRODUCTS

2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Control Panels for Monitoring and Control Operator Interface:
 - 1. Touchscreen video control panels.
 - 2. Hard control panels.
- B. Normal System and Device Programming Equipment:
 - 1. Dedicated administrative management computer.
 - 2. Touchscreen video control panel.
 - 3. Hand-held portable computer.
- C. Interconnection of Touchscreen Video Control Panels: Through a [peer-to-peer] [dedicated touchscreen file server] network.
- D. Interconnection of PLCs with Each Other and with Control Panels: Through a PLC network.
- E. Interface between PLC System and Controlled and Monitored Devices: Relay assemblies.
- F. Systems Integration: Detention monitoring and control system shall be integrated with features and functions of the following systems and equipment:
 - 1. Lighting controls specified in Section 260943 "Network Lighting Controls."
 - 2. Intercommunication and paging specified in Section 275123.20 "Commercial Intercommunications and Program Systems." Fire alarm system specified in [Section 284621.11 "Addressable Fire-Alarm Systems."] [Section 284621.13 "Conventional Fire-Alarm Systems."]
 - 3. [Perimeter protection] [Perimeter protection and intrusion detection] [Intrusion detection] specified in Section 283121 "Area and Perimeter Intrusion Detection."
 - 4. Closed-circuit television specified in Section 282000 "Video Surveillance."
 - 5. <Insert systems to be integrated.>
- G. Reliability: Components, arrangement, assembly, construction, wiring, connections, integration, adjustments, and system programming shall have a reliability such that no single malfunction or equipment failure can impair the normal operational control function of more than [20] <Insert number> percent of doors and associated components controlled by the overall system.
- H. Independent Operation: System equipment, software, operation, controls, and communications shall provide, as an optional emergency control mode, totally independent operation for the primary local control panel for each operational area.
- I. System Response Time: For indicated items, shall be within the following limits:
 - 1. Mechanical Locking and Unlocking of Doors: Within one second of operator action at control panel.

2. Initiate Mechanical Movement of Electrically Controlled [Doors] [Doors and Gates] [Gates]: Within one second of operator action at control panel.
 3. Initiate Audible and Visual Indications at Control Panels: Within one second of change of state of monitored field devices, or of alarm or intercom call-in events.
 4. Initiate Automatic Switching[and Start of Automatic Countdown Cycles]: Within one second of occurrence of specified triggering event.
- J. Automatic Logging of System Events: To [a system CPU] [a touchscreen CPU] [an administrative management computer] <Insert designation of system event log maintenance unit>.
1. Stores, processes, and reports on logged data using an approved software package designed for the purpose.
 2. Events to Be Logged: System shall be capable of logging any combination of events that may be registered on the system. Provide logging of the following events in initial programming of the system:
 - a. Operator log-on and log-off.
 - b. Alarms and alarm responses.
 - c. Door interlock overrides.
 - d. Gate operation.
 - e. <Insert required logging.>
 3. Data to be Logged for Each Event:
 - a. Date and time of occurrence.
 - b. Action-point identification.
 - c. Operator name (for operator actions).
- K. Audible Tone: A distinctive, audible, confirmation signal tone shall sound locally for 0.25 second each time an operator performs a switching, selection, acknowledgment, silence, reset, or other similar operation at a control panel.

2.2 COMPONENT PROTECTION

- A. Surge Protection: Protect components from voltage surges originating external to equipment housings and entering through power, communication, signal, control, and sensing leads. Include surge protection for external wiring of each conductor entry connecting to components.
1. Minimum Protection for AC Power Circuits 120 V and More: Multistage surge suppressors, listed under UL 1449, using a combination of inductors and silicon avalanche diodes or equivalent, and with 300-V suppression level and 5-nanosecond maximum response time.
 - a. Silicon Avalanche Diodes: Bipolar, Grade A, plus or minus 5 percent tolerance.
 - b. Discrete SPD Units External to Protected Equipment: Enclosed modules with indicating lights labeled "power on" and "failure."
 2. Minimum Protection for Communication, Signal, Data, Control, and Low-Voltage Power Circuits: [Silicon avalanche diode] [Gas-discharge] [MOV] [Silicon avalanche diode, gas-discharge, or MOV]-type arresters rated 90 V at 5000 A[, or optical isolation,] [or as recommended by equipment manufacturer].
- B. Interference Protection: Component function shall be unaffected by radiated-radio-frequency interference and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz, or by conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.

2.3 HARD CONTROL PANELS

- A. Membrane-Switch Control Panels: Flat-panel type with LED indicating lights and membrane switches.

1. Panel Configuration: Switches and LEDs shall be arranged [on a scaled graphic replication of floor plan] [in a tabular functional layout].
- B. Electromechanical-Switch Control Panels: Flat-panel type with LED indicating lights and electromechanical switches.
 1. Panel Configuration: Switches and LEDs shall be arranged [on a scaled graphic replication of floor plan]
- C. Construction: Devices, media, and work surface shall be assembled on a subbase consisting of a flat [aluminum] [aluminum or plexiglass] [plexiglass] plate as follows:
 1. Minimum Aluminum Subbase Thickness: [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)].
 2. Minimum Plexiglass Subbase Thickness: [1/4 inch (6.4 mm)] [5/16 inch (8 mm)].
 3. Top for Membrane-Switch Panels: Flexible, three-layer sheet laminate membrane with clear, nonglare-textured, [polycarbonate film] [synthetic polymer] [PVC] [polycarbonate film, synthetic polymer, or PVC] work surface with polyester-film, middle-layer, [silk-screened] [printed] [photoemulsion printed] [silk-screened, printed, or photoemulsion printed], UV-resistant graphics on reverse side. Bottom layer shall be [magnetic sheet] [flexible peel-off] material arranged for attachment to and removal from subplate without damage to laminate assembly. Laminate the three layers and assemble to subplate with no blemishes, humps, or creases. Materials and arrangement shall be coordinated with membrane-switch characteristics so pressure required to operate installed membrane switches is between 4 and 9 ounces force (1.11 and 2.50 N).
 4. Top for Electromechanical-Switch Panels: Flexible, two-layer sheet laminate with clear, nonglare-textured, [polycarbonate film] [synthetic polymer or PVC] [PVC] work surface with polyester-film, bottom-layer, [silk-screened] [printed] [photoemulsion printed], UV-resistant graphics on reverse side.
 5. Plastic Materials: Nontoxic and flame retardant.
 6. Scale for Graphic Floor Plan: So switches and LEDs are within the lines enclosing the spaces they control or monitor.
 7. Device Mounting: Removable from bottom of subpanel.
 - a. Membrane Switches and Associated LEDs: Secured to subpanel with top flush with back of graphic film.
 - b. Electromechanical Switches and Associated LEDs: Secured to subpanel with operating parts exposed at work surface and sealed around exposed parts with bezel.
 - c. Terminal Strips and Auxiliary Components: Mounted to underside of control panel.
- D. Mounting: Secure control panel to [console base] [turret] <Insert mounting>.
 1. Panel shall be hinged at top with heavy-duty, continuous metal hinges arranged so devices and their wiring connections become fully accessible when panel is opened.
 2. Panel shall be secured to base in closed position with listed, high-security-rated, locking assemblies. Locks shall have bolts that latch top panel assembly to base at each front corner.
 3. [Console Base] <Insert mounting>: Internally reinforced to resist panel movement during a seismic event when base is anchored to building structure.
- E. Wiring: Factory wired, with multiconductor cable secured to underside of panel with straps at 1-inch (25-mm) maximum intervals and extra straps and cable sheath reinforcing sleeve where conductors break out for connections.
 1. Circuits: Power limited, 12-V dc, maximum.
 2. Connections to Control Panel Devices and Components: Solderless, quick-disconnect, plug or sleeve connectors.
- F. Control Panel LEDs:

1. Description: Miniature socket-mounting, high-intensity type; colors as indicated; sealed against moisture and dust.
 2. Rating: 20 mA, with overload capacity up to 70 mA without affecting life expectancy.
 3. Operating Life: 100,000 hours minimum.
 4. Viewing Angle: 90 degrees.
 5. Body and Lens Material: High-impact polycarbonate.
 6. Socket Wiring Terminations: Quick-disconnect sockets.
- G. Control Panel Switches, Electromechanical Type:
1. Description: Sealed units rated for a minimum of 5-A inductive load at 28-V dc.
 2. Rated Life: 250,000 cycles minimum, at rated voltage and current.
- H. Control Panel Switches, Membrane Type:
1. Description: Sealed, touch activated, with a maximum contact resistance of 1 ohm, and a minimum rating of 33 mA at 24-V dc.
 2. Contacts: Momentary and maintained configurations.
 3. Rated Life: 50,000,000 cycles with a minimum load of 0.5 mA at 12-V dc.
- I. Operational Performance of Control Panels: Include the following control, monitoring, and performance functions by hard control panels and associated equipment and circuits:
1. Audible and Visual Alarm Indications and Controls: Red alarm LED flashes and a distinctive tone pulses continuously at control panel when an alarm condition or uncontrolled change of state occurs in controlled or monitored circuits or equipment.
 - a. Tone is silenced by momentary-contact silence switch, and LED becomes steady.
 - b. Depressing the momentary-contact reset switch extinguishes LED for alarms that can be locally reset.
 2. Door Status Visual Indications: Denoted by LEDs at door control switches as follows:
 - a. Nonsecure: Red LED.
 - b. Secure: Green LED.
 - c. Alarm (Door Position or Lock Status Inconsistent with Control Position or Status): Flashing red LED.
 3. Panel-Controlled, Locking and Unlocking, Single Swing Doors:
 - a. Operation of switch locks and unlocks door.
 - b. Switch:
 - 1) Single, momentary contact, lock and unlock type.
 - 2) Maintained contact, two-position paddle, lock and unlock type.
 4. Panel-Controlled, Unlocking and Automatic-Locking, Single Swing Doors:
 - a. Operation of control switch unlocks door for a period programmable from 1/2 to 10 seconds.
 - b. Switch: Momentary contact.
 5. Electrically or Pneumatically Operated [Door] [Gate] [Door and Gate]: Single switch for each unit for open and close control. Operation of switch applies power, initiating opening or closing. Limit switch supplied with mechanism stops unit at end of its travel. If switch is operated during opening or closing cycle, mechanism stops for one second before reversing.
 - a. Switch: [Two-position, maintained-contact paddle] [Single-pole, momentary contact].
 6. Electrically or Pneumatically Operated Door with Open, Stop, and Close Control:
 - a. Selection of open position, or switch, applies power, initiating open cycle. Selection of stop position, or switch, while mechanism is in opening or closing cycle, stops motion. Selection of close position, or switch, applies power, initiating closing cycle. Limit switch supplied with mechanism stops unit at end of its travel.

- b. Switch Configuration: [One three-position paddle switch] [Three momentary-contact switches].
- 7. Individually Controlled Cell Doors: Two-position paddle switch. One position locks door, and the other unlocks door.
- 8. Individually Controlled Cell Doors: Single momentary-contact switch. Depressing the switch locks or unlocks door, depending on current status.
- 9. Individually Controlled Cell Doors: Two momentary-contact switches. One switch locks door, and the other unlocks door.
- 10. Group-Controlled or Individually Controlled Doors:
 - a. Switch: Maintained-contact paddle switch with three positions: Lock, unlock, and group assign.
 - b. Switch: Two momentary-contact switches. One switch locks or unlocks door, depending on current status, and the other assigns or unassigns door for group operation.
 - c. Switch: Two momentary-contact switches. Depressing one switch locks or unlocks door, depending on current status. Second switch, when operated simultaneously with the panel group door assign and unassign switch, either assigns or unassigns door for group operation, depending on current status.
 - d. Indications: Yellow LED at individual door assign and unassign switch is lighted when door is assigned for group operation.
- 11. Group Door Assign and Unassign Switch: Momentary-contact switch.
 - a. Depressing and holding this switch lights the red LED at control switch for each door that is currently assigned for group operation, and permits unassigning any of those doors by momentarily depressing the associated lock and unlock switch.
 - b. Doors not currently assigned are assigned for group operation by momentarily depressing the associated lock and unlock switch while the group assign and unassign switch continues to be depressed.
 - c. Assigning and unassigning operations shall not lock or unlock doors.
- 12. Group Door Locking and Unlocking:
 - a. Two position, maintained-contact paddle switch. Lock position locks, and unlock position unlocks, group-switched doors.
 - b. Guarded momentary-contact switch. Depressing the switch locks or unlocks doors in group, depending on current group status.
 - c. Two momentary-contact switches; one for locking and the other for unlocking.
 - d. Locking or unlocking of group doors is performed individually at one-second intervals.
- 13. Cell Door Inmate-Access Lockout: One switch on control panel for each cell door.
 - a. Depressing a momentary-contact inmate-access switch enables an inmate-operated [local electric key] [push-button, inmate door-control switch] that locks and unlocks cell door. [Local electric keys] [Push-button, inmate door-control switches] are specified in Section 087163 "Detention Door Hardware."
 - b. Depressing the switch again disables operation of inmate access when provided by operation of group inmate-access switch.
 - c. When inmate access is enabled] <Insert color> LED at switch is lighted; otherwise, LED is not lighted.
- 14. Group Inmate-Access Switch: Controls on-off status of inmate access for cells in group that have this function enabled.
 - a. Depressing the momentary-contact switch turns function on or off, depending on current condition.
 - b. When cell group is in inmate-access mode, LED at switch is lighted; otherwise, LED is not lighted.
- 15. Door Interlocking: Interlocks designated groups of doors[and gates
 - a. Effect: When one door in a group is unlocked or open, the others in the group are prevented from being unlocked[or opened].

- b. Override When One Door of an Interlocked Group Is Nonsecure: Simultaneous momentary operation of interlock override switch and unlock or open switches for secured interlocked doors to be opened overrides the interlocking for those doors.
 - c. Override When One Door of an Interlocked Group Is Nonsecure: Simultaneous momentary operation of two interlock override switches and the unlock or open control for secured interlocked doors to be opened overrides the interlocking for those doors.
 - d. Indications When in Override Mode: Additional [yellow] <Insert color> LEDs at locking switch for each interlocked door and at override switch, and a distinctive audible tone.
 - 1) All Doors in Group Secure: LEDs, tone for doors in group, and override switch are off.
 - 2) One Door of Interlocked Group Nonsecure: [Red] <Insert color> LED for nonsecure door is lighted; [yellow] <Insert color> LEDs for doors in group are on continuously; there is no tone.
 - 3) Two or More Doors in Group Nonsecure: LEDs flash for doors in group, tone pulses, and momentary operation of silence switch silences tone.
- 16. Operator-Controlled Emergency Door Release - Single-Switch Control: Operation of guarded, maintained-contact, emergency-release switch unlocks designated locked doors and keeps them unlocked.
 - a. Next operation of switch locks door.
 - b. Locking or unlocking of doors is performed individually at one-second intervals.
 - c. Indications: Red LED at emergency-release switch is lighted and sounds a distinctive tone.
 - 1) When emergency-release switch unlocks doors, LED flashes continuously five times per second, and audible alarm pulses.
 - 2) Silence switch silences audible alarm.
 - 3) When doors are relocked or alarm-reset switch is operated, LED is extinguished and alarm is silenced.
- 17. Operator-Controlled Emergency Door Release - Two-Switch Control: Simultaneous operation of two momentary-contact, emergency-release switches unlocks designated doors.
 - a. Second simultaneous operation of the two switches returns locks to normal operation.
 - b. Locking or unlocking of doors is performed individually at one-second intervals.
 - c. Indications: [Red] <Insert color> LED at the pair of emergency-release switches is lighted and sounds a distinctive tone.
 - 1) When emergency-release switches unlock doors, LED flashes continuously five times per second, and audible alarm pulses.
 - 2) Silence switch silences audible alarm.
 - 3) When doors are relocked or alarm-reset switch is operated, LED is extinguished and alarm is silenced.
- 18. Automatic Fire-Door Release: A signal from fire alarm control panel triggers automatic, sequential, timed release of doors in a specific zone. Fire alarm system determines which doors are to be released.
 - a. Doors in egress path are released first, after a timed countdown period.
 - b. When doors in egress path are unlocked, a countdown period for release of cell doors begins.
 - c. Countdown periods are of programmable duration.
 - d. Countdown may be stopped during either period by actuating an abort switch at control panel.
 - e. If there is an additional fire alarm signal from the same zone after countdown has been aborted but before smoke detectors have been cleared and fire alarm system reset, system shall restart the countdown;

- the restarted countdown shall have the same time remaining as remained when cycle was aborted.
- f. If there is an additional fire alarm signal from a different zone before original initiating smoke detectors are cleared and fire alarm system is reset, countdown shall begin in new zone with same time remaining as remained for original alarm zone at time of second alarm.
 - g. Locking or unlocking of doors is performed individually at one-second intervals.
 - h. Indications: One LED and a distinctive audible tone for each countdown cycle.
 - 1) While cycle is in progress, LED for that cycle shall flash five times per second, and tone shall pulse once for each second of countdown.
 - 2) When doors are released, nonsecure LEDs for those doors shall flash continuously.
 - 3) During each countdown cycle, digital clock in control panel shall count down the time remaining before release of doors in that cycle.
19. Intercommunication Control:
- a. Incoming Intercom Call: When staff[or inmate] station initiates a call to control panel station, a distinctive tone sounds and a [yellow] [green] LED at station switch flashes.
 - b. Operator acknowledges call by depressing the momentary-contact intercom switch associated with calling station[or momentary-contact acknowledge switch]. LED is lighted steadily, and tone ceases.
 - c. Acknowledgment of call opens an audio path to calling station and permits two-way conversation using push-to-talk switch and microphone[or handset].
 - d. Operating the switch again, or selecting another station, terminates the connection; LED at first station switch is extinguished.
 - e. Listening or Outgoing-Call Function: Operator selects staff[or inmate] station by operating the station switch. Operator may listen or proceed with two-way conversation using push-to-talk switch and microphone[or handset]. Selecting station again, or selecting another station, terminates the connection.
20. Paging: Operator transmits paging announcements by operating a momentary-contact [paging] [paging zone] switch, closing a momentary-contact push-to-talk switch, and using microphone[or handset]. [Yellow] [Green] LED lights at [paging] [paging zone] switch until it is operated again to terminate the connection.[Multiple zones may be paged simultaneously by operating more than one paging zone switch before transmitting.]
21. Audio-Level Alarm: Depressing the momentary-contact, audio-level-alarm switch shall place intercom system in monitoring mode for cell noise level.
- a. Red LED at audio-level-alarm switch is lighted when system is in alarm mode.
 - b. When in alarm mode, system alarms when noise level in any cell exceeds an adjustable preset threshold. Green LED flashes at control panel intercom station switch for the cell originating the alarm, and an audible alarm tone pulses.
 - c. Depressing the silence switch silences audible alarm and causes green LED to light steadily.
 - d. When reset switch is operated, green LED is extinguished.
22. Video Switching Control:
- a. Signal from assigned camera is automatically switched to spot monitor at control panel when the following occurs:
 - 1) Operator selects associated intercommunication station by operating the selector switch for the station, by acknowledging incoming intercom call, or by operating the camera switch.

- 2) A staff-duress alarm is initiated in the vicinity of camera.
 - 3) <Insert initiating events for automatic camera switching.>
 - b. Video signal from assigned camera is manually switched to spot monitor at control station when operator operates momentary-contact camera switch.
 - c. Green LED on the graphic control panel identifies and locates video camera currently providing the signal for spot monitor at control panel location.
23. Cell Lighting Control: A three-position, maintained-contact paddle switch for each cell provides individual on, off, and inmate control.
- a. On-off switch positions energize and de-energize lights[and receptacles]. Inmate position[energizes receptacles and] permits local control of lights within the cell.
 - b. Indications: [Green] [Orange] LED at switch indicates when lighting [is] [and power are] on.
24. Cell Lighting Control: Two momentary-contact switches for each cell provide individual on, off, and inmate control of lights[and receptacles].
- a. Depressing the inmate switch energizes receptacles and permits or removes local control of lights within cell, depending on current status.
 - b. Depressing the light switch turns lights and receptacles on or off, depending on current status.
 - c. Indications: [Green] [Orange] LED at light switch is lighted when lighting [is] [and power are] on; otherwise, LED is not lighted. [Green] [Orange] LED at inmate switch is lighted when inmate control is enabled.
25. Electrical Circuit On-Off Switching Control for Designated Outlets: [Two-position, maintained-contact, on-off paddle switch controls] [Single maintained-contact, on-off switch controls] [Two momentary-contact, on-off switches control] energizing and de-energizing of circuits and equipment.
- a. Selecting the on position or switch turns circuit on. Selecting the off position or switch turns circuit off.
 - b. Indications: [Green] [Orange] LED at switch indicates when circuit is on.
26. Fire Alarm System Status Indications:
- a. Red fire alarm LED flashes when alarm occurs.
 - b. Red LED for each zone flashes when alarm occurs for that zone.
 - c. Red LED for each detection device and each manual station flashes when that device or station is in an alarm state.
 - d. Audible alarm tone pulses when alarm signal occurs.
 - e. Depressing the silence switch silences audible tone and causes LED to light steadily. After fire alarm system is reset, operating the reset switch extinguishes LED.
27. Smoke Control: Operating the smoke-control switch initiates a signal to HVAC system controls to start preestablished smoke-control operating mode for local zone. Yellow LED at switch flashes continuously to verify that HVAC system is operating in smoke-control mode.
28. Duress-Status Indications: When staff-duress device for a zone is activated, red staff-duress LED for that zone flashes and audible alarm tone pulses. Operating the silence switch silences audible alarm and causes LED to light steadily. Operating the reset switch extinguishes LED.
29. Elevator Security Controls: <Insert description of functions to be provided.>
30. Perimeter Security System Status Indications:
- a. Red alarm LED is normally off. LED flashes and audible alarm tone pulses when alarm occurs.
 - b. Red alarm LED for each detection zone is normally off. When an alarm occurs for a zone, LED for that zone flashes and audible alarm tone pulses.
 - c. Depressing the silence switch silences audible tone and causes LED to light steadily. After perimeter system is reset, operating the panel reset switch extinguishes LED.

31. Override of Normal Control for Operation of Exhaust Fans:
 - a. Depressing the momentary-contact, exhaust-fan switch starts designated fans for an operating cycle of programmable duration. Fans turn off automatically when cycle ends.
 - b. Indications: Yellow LED at switch is lighted steadily when fans are on; otherwise, LED is not lighted.
32. Water-Flow Control: On-off control at central control panel for designated [showers] [fixtures] [showers and fixtures].
 - a. Depressing the momentary-contact, water-on switch opens solenoid valve in supply line. Depressing the switch again closes valve.
 - b. Indications: Yellow LED at switch is lighted when water is on; otherwise, LED is not lighted.
33. Trouble Alarm Indications for Auxiliary and Utility Systems: Audible and visual indications providing a single nondifferentiated alarm for certain systems and equipment.
 - a. Monitored Conditions:
 - 1) Failure of normal electrical utility supply.
 - 2) Malfunction of generator set and standby power supply.
 - 3) UPS malfunction.
 - 4) Compressed-air system malfunction.
 - 5) HVAC system malfunction.
 - 6) Network malfunction.
 - 7) PLC fault.
 - b. Red alarm LED is normally not lighted. When failure or malfunction occurs, light flashes and alarm tone pulses.
 - c. Depressing the silence switch silences audible tone and causes LED to light steadily.
 - d. If a second malfunction occurs while alarm is silenced but before reset, light flashes and alarm tone pulses again.
 - e. After alarm condition is corrected, operating the reset switch extinguishes LED.
34. Panel Control-Power Switch: Key-operated switch turns power to control panel on and off and enables operation.
 - a. Indications: Green LED is lighted when panel is enabled; otherwise, LED is not lighted.
35. Remote-Panel Enable Switch: Guarded momentary-contact switch turns control power on and off for <Insert designation of satellite control panel>.
 - a. Indications: Green LED is lighted when satellite panel is enabled; otherwise, LED is not lighted.

2.4 TOUCHSCREEN VIDEO CONTROL PANELS

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Description: Computer-operated, video control unit complying with 47 CFR 15, Subparts A and B, for Class A and B digital devices and having dynamic presentation of annunciation and controls on a monitor equipped with a touch-sensitive panel overlay on the front of display screen. Include the following minimum features, components, and capabilities:
 1. CPU: IBM-compatible computer housed in an industrial chassis and having the following requirements:
 - a. CPU Speed and Capacity: <Insert processor speed and cache capacity.>
 - b. RAM: <Insert capacity in megabytes or gigabytes and memory type.>
 - c. Fixed Disk Drive: <Insert capacity in gigabytes or terabytes.>
 - d. CD-ROM Drive: 40.
 - e. Floppy Disk Drive: One, 3-1/2 inches.

- f. Internal Backup Tape Drive: <Insert capacity in gigabytes or terabytes.>
 - g. Sound Card: <Insert bit speed and type of card.>
 - h. One serial and one parallel port in addition to those required for detention monitoring and control.
 - i. Network Interface Cards: Matched to protocol and media used for each network.
 - j. Modem: Internal,
 - k. Automatic Reboot Capability: When power is restored after an outage.
 - l. Operating System:
 - 2. Monitor and Touchscreen Panel: [21 inches (533 mm)With [1280 by 1024] <Insert number> resolution.
 - a. On-Screen Colors: [256]
 - b. Video Card Capacity: <Insert capacity in megabytes>, VRAM with capture.
 - c. Interface Overlay: Capacitive touch Surface acoustic wave [Capacitive touch or surface acoustic wave] switching system.
 - 1) Single, Transparent-Glass, Panel Type: 92 percent light transmission.
 - 2) Touch Position Accuracy: Maximum error; 0.125 in. (3.18 mm).
 - 3) Touch Endurance: 2,000,000 finger touches at 12-ounce force (3.34-N) pressure at any selected point, regardless of screen size, without failure or noticeable degradation.
 - 4) Activation Force Required for Switching: [1 to 12 ounces force (0.3 to 3.34 N)] [1 to 8 ounces force (0.3 to 2.23 N)], software adjustable.
 - 3. Peripheral Components:
 - a. Keyboard: <Insert system.>
 - b. Printer: Comply with "Printer" Article.
 - c. Mouse: [Two] [Three]-button model.
 - d. Speakers: Two amplified computer speakers.
- C. General Functional Performance:
 - 1. Video display shall be connected so an operator can interact with and control the computer, responding to inputs and creating outputs that control external functions.
 - 2. Data from external sensors and signal sources shall be processed by external I/O units, PLCs, and the computer, and initiate displays of system and equipment status, activity, and other information on the monitor and through related signal devices. Where indicated, data from external sensors and signal sources also initiate automatic system responses.
 - 3. Software correlates various points on the touch-sensitive panel with software-generated graphics so operational outputs are created by touching the screen at locations defined by the graphics.
 - 4. Touch-panel outputs shall be processed by computer and by integrated external I/O modules and PLCs to produce control signals and operating voltages for switching devices and relays that control those devices.
 - 5. Computer software shall provide pop-up and tool-bar-type menus and special icons that guide the operator in responding to events and in switching to different screen displays to obtain access to different control panel functions.
- D. Detailed Operational Performance: Include the following control, monitoring, and performance functions by touchscreen video control panels and associated equipment and circuits:
 - 1. Global Functions: Touching the [icons] [toolbar buttons] [icons or toolbar buttons] at the bottom of each graphic screen, and elsewhere as indicated, controls the following functions:
 - a. Operator Log-On and Log-Off: Dialog box appears for password entry[without use of a keyboard].

- 1) Logging Off: Dialog box prompts operator to verify intent to log off, and to either exit the process or complete it.
- 2) Completion of log-off process displays log-on screen for the next operator to access touchscreen functions.
- b. Map Finder: Graphic map index appears with provision for the operator to select a map and its associated functions to be displayed.
- c. Clean Screen: All icons and graphics are extinguished for 15 seconds to facilitate physical cleaning of control panel screen surface.
- d. System Utilities: System management screen appears, presenting functional choices appropriate for the logged-on operator's programmed access level; choices inappropriate for the operator appear in dialog box but are grayed out to indicate they are inactive. Choices include the following:
 - 1) Configure station users.
 - 2) Change password.
 - 3) Calibrate touchscreen.
 - 4) Set date and time.
 - 5) <Insert utility functions to be presented.>
- e. Scroll to Adjacent Area: Four icons[or buttons], one on each side of the screen, near the edge. Touching these icons selects the screen for adjacent area on that side of area currently displayed.
2. Audible and Visual Alarm Indications and Controls: Red alarm icon flashes and a distinctive tone pulses continuously at control panel when an alarm condition or uncontrolled change of state occurs in controlled or monitored circuits or equipment.
 - a. Tone is silenced by momentary-contact silence control icon, and status icon becomes steady.
 - b. Depressing the momentary-contact reset control icon extinguishes status icon for alarms that can be reset at control panel.
3. Door Status Visual Indications: Denoted by status icon at door control icon as follows:
 - a. Nonsecure: Red icon.
 - b. Secure: Green icon.
 - c. Alarm (Door Position or Lock Status Inconsistent with Control Position or Status): Flashing red icon.
4. Panel-Controlled, Locking and Unlocking, Single Swing Doors: Operation of control icon locks or unlocks door, depending on current status.
5. Panel-Controlled, Unlocking and Automatic-Locking, Single Swing Doors: Operation of control icon unlocks door for a period programmable from 1/2 to 10 seconds.
6. Power-Operated [Door] [Gate] [Door and Gate] with Open and Close Control: Operation of open control icon applies power, initiating opening. Limit switch supplied with [door] [gate] [door or gate] mechanism stops unit at end of its travel. If control icon is operated during opening or closing cycle, mechanism stops for one second before reversing.
7. Power-Operated [Door] [Gate] [Door or Gate] with Open, Stop, and Close Control: Operation of open control icon applies power, initiating open cycle. Touching the stop control icon while mechanism is in open or close cycle stops motion. Touching the close control icon applies power, initiating close cycle. Limit switch in mechanism stops unit at end of its travel in either direction.
8. Individually Controlled Cell Doors: Touching the control icon locks or unlocks door, depending on current status.
9. Doors with Both Individual and Group Control:
 - a. Touching the individual door control icon locks or unlocks door, depending on current status.
 - b. Touching the group control icon locks or unlocks doors assigned for group operation, depending on current group control enablement status of individual doors.

- c. Doors are individually enabled for group locking and unlocking using separate group assign and unassign control icon.
- 10. Assign and Unassign Group-Door Function:
 - a. Touching the group door assign and unassign control icon lights that icon and a red status icon at each door that is currently assigned for group operation, and permits unassigning any of those doors by touching the associated lock and unlock control icon.
 - b. Doors not currently assigned are assigned for group operation by touching the associated lock and unlock control icon while group assign and unassign control icon continues to be lighted.
 - c. Touching the group door assign and unassign control icon again returns system to normal operating mode.
- 11. Group Door Control, Locking and Unlocking: Touching the group lock and unlock control icon locks doors in group if they are currently unlocked. If doors are locked, action presents a dialog box requiring operator confirmation before unlocking doors assigned to group.
 - a. Locking or unlocking of doors is performed individually at one-second intervals.
- 12. Cell Door Inmate-Access Lockout: One control icon on screen for each cell door.
 - a. Touching the inmate-access control icon disables an inmate-operated [local electric key] [push-button, inmate door-control switch] that locks and unlocks cell door. [Local electric keys] [Push-button, inmate door-control switches] are specified in Section 087163 "Detention Door Hardware."
 - b. Touching the control icon again enables operation of inmate access when provided by operation of group inmate-access control icon.
 - c. When inmate access is enabled, [orange] <Insert color> status icon at door is lighted; otherwise, icon is not lighted.
- 13. Group Inmate-Access Control: Controls on-off status of inmate-access control for cells in group that have this function enabled.
 - a. Touching the icon turns function on or off, depending on current condition.
 - b. When cell group is in inmate-access mode, orange status icon at switch is lighted; otherwise, icon is not lighted.
 - c. Locking or unlocking of doors is performed individually at one-second intervals.
- 14. Door Interlocking: Interlocks designated groups of doors[and gates].
 - a. Effect: When one door in a group is unlocked or open, the others in the group are prevented from being unlocked[or opened].
 - b. Override When One Door of an Interlocked Group Is Nonsecure: Simultaneous operation of interlock override control icon and unlock or open control icons for other doors in group overrides the interlocking for those doors and permits them to be unlocked and opened for a time interval of programmable duration, set at 10 seconds.
 - c. Override When One Door of an Interlocked Group Is Nonsecure: Simultaneous, momentary operation of 2 interlock override control icons and the unlock or open control icon for secured interlocked doors to be opened overrides the interlocking for those doors and permits them to be unlocked and opened for a time interval of programmable duration, set at 10 seconds.
 - d. Override When One Door of an Interlocked Group Is Nonsecure: Touching the interlock override control icon presents a dialog box requiring operator confirmation before placing nonsecure interlocked door group in an override mode.
 - 1) Override mode permits doors in group to be unlocked and opened for a time interval of programmable duration, set at 10 seconds.

- e. Interlocked Door Indications: The following status indications apply to interlocked doors in addition to specified indications for controlled doors:
 - 1) Door status icons for secure doors light steadily yellow when one door in group is nonsecure; icons flash yellow when group is in override mode.
 - 2) When two or more doors in group are nonsecure, status icons for doors in group flash red; tone pulses; touching the silence control icon silences tone.
- 15. Operator-Controlled, Emergency Door Release: Operation of emergency-release control icon presents a dialog box requiring operator confirmation before unlocking designated doors. Doors remain unlocked until relocked individually or in groups.
 - a. Next operation of icon locks door.
 - b. Locking or unlocking of doors is performed individually at one-second intervals.
 - c. Indications: Red status icon at emergency-release control icon is lighted and sounds a distinctive tone.
 - 1) When emergency-release control icon unlocks doors, status icon flashes continuously five times per second and audible alarm pulses.
 - 2) Touching the silence control icon silences audible alarm.
 - 3) When doors are relocked or alarm-reset control icon is touched, status icon is extinguished and alarm is silenced.
- 16. Automatic Fire-Door Release: A signal from fire alarm control panel triggers automatic, sequential, timed release of doors in a specific zone. Fire alarm system determines zone(s) for which doors are to be released.
 - a. Doors in egress path are released first, after a timed countdown period.
 - b. When doors in egress path are unlocked, a countdown period for release of cell doors begins.
 - c. Countdown periods are of programmable duration.
 - d. Countdown may be stopped during either period by actuating an abort control icon at control panel.
 - e. If there is an additional fire alarm signal from same zone after countdown has been aborted but before smoke detectors have been cleared and fire alarm system reset, system shall restart the countdown; the restarted countdown shall have the same time remaining as remained when cycle was aborted.
 - f. If there is an additional fire alarm signal from a different zone before original initiating smoke detectors are cleared and fire alarm system is reset, countdown shall begin in the new zone with the same time remaining as remained for original alarm zone at time of second alarm.
 - g. Locking or unlocking of doors is performed individually at one-second intervals.
 - h. Indications: A separate countdown status icon and a distinctive audible tone designated for each countdown cycle shall indicate the countdown is in process.
 - 1) While cycle is in progress, icon for that cycle shall flash five times per second and tone shall pulse once for each second of the countdown.
 - 2) When doors are released, nonsecure status icons for those doors shall begin flashing continuously.
 - 3) During each countdown cycle, digital clock in the control panel shall count down the time remaining before release of doors in that cycle.
- 17. Intercommunication Control:
 - a. Incoming Intercom Call: When staff[or inmate] station initiates a call to control panel station, a distinctive tone sounds and [yellow] [green] icon at station control icon flashes.

- b. Operator acknowledges call by touching the intercom control icon associated with calling station or the acknowledge control icon. Status icon is lighted steadily and tone ceases.
 - c. Acknowledgment of the call opens an audio path to calling station and permits operator to conduct two-way conversation using push-to-talk switch and microphone[or handset].
 - d. Operating the control icon again, or selecting another station, terminates the connection and the status icon at first station is extinguished.
 - e. Listening or Outgoing-Call Function: Operator selects staff[or inmate] station by operating the station select control icon. Operator may listen or proceed with two-way conversation using push-to-talk switch and microphone[or handset]. Selecting station again, or selecting another station, terminates the connection.
- 18. Paging: Operator transmits paging announcements by touching a momentary-contact [paging] [paging zone] control icon, closing a momentary push-to-talk switch, and using microphone[or handset]. [Yellow] [Green] status icon lights at [paging] [paging zone] control icon until it is operated again to terminate the connection.[Multiple zones may be paged simultaneously by operating more than one paging zone control icon before transmitting.]
- 19. Audio-Level Alarm: Touching the audio-level-alarm control icon shall place intercom system in monitoring mode for cell noise level.
 - a. Red icon at audio-level-alarm control icon is lighted when system is in alarm mode.
 - b. When in alarm mode, system alarms when noise level in any cell exceeds an adjustable preset threshold. Green icon flashes at control panel intercom station control icon for the cell originating the alarm, and audible alarm tone pulses.
 - c. Touching the silence control icon silences audible alarm and causes green icon to light steadily.
 - d. When reset control icon is operated, the green status icon is extinguished.
- 20. Video Switching Control:
 - a. Signal from assigned camera is automatically switched to spot monitor at control panel when the following occurs:
 - 1) Operator selects associated intercommunication station by operating the selector control icon for the station, by acknowledging incoming intercom call, or by touching the camera control icon.
 - 2) A staff-duress signal is initiated in the vicinity of camera.
 - b. Video signal from assigned camera is manually switched to spot monitor at control station when operator touches camera control icon.
 - c. Green status icon on the graphic control panel identifies and locates the video camera currently providing the signal for spot monitor at control panel location.
- 21. Cell Lighting Control: Two control icons for each cell provide on-off and inmate control for lights[and receptacles] in each cell.
 - a. Touching the inmate control icon energizes receptacles and enables or disables local control of lighting within cell, depending on current status.
 - b. Touching the on-off control icon turns lights and receptacles on or off, depending on current condition.
 - c. Indications: [Green] [Orange] icon at on-off control icon is lighted when [lighting is] [lighting and power are] on; otherwise, icon is not lighted. [Green] [Orange] icon at inmate control icon is lighted when inmate control is enabled.
- 22. Electrical Circuit On-Off Switching Control: A control icon for each function toggles between on and off to energize and de-energize circuits.
 - a. Indications: [Green] [Orange] icon at control icon indicates when lighting or power is on.

23. Fire Alarm System Status Indications:
 - a. Red fire alarm icon flashes when alarm occurs.
 - b. Red icon for each zone flashes when alarm occurs for that zone.
 - c. Red icon for each detection device and each manual station flashes when that device or station is in an alarm state.
 - d. Audible alarm tone pulses when alarm signal occurs.
 - e. Depressing the silence control icon silences audible tone and causes status icon to light steadily. After fire alarm system is reset, touching the reset control icon extinguishes status icon.
24. Smoke Control: Touching the smoke control icon initiates a signal to HVAC system controls to start preestablished smoke-control operating mode. Yellow status icon flashes continuously to confirm HVAC system is operating in smoke-control mode.
25. Duress-Status Indications: When staff-duress device for a zone is activated, red staff-duress status icon for that zone flashes and audible alarm tone pulses. Operating the silence control icon silences audible alarm and causes status icon to light steadily. Operating the reset control icon extinguishes status icon.
26. Elevator Security Controls: <Insert description of functions to be provided.>
27. Perimeter Security System Status Indications:
 - a. Red alarm icon is normally off. Icon flashes and audible alarm tone pulses when alarm occurs.
 - b. Red alarm icon for each detection zone is normally off. When an alarm occurs for a zone, icon for that zone flashes and audible alarm tone pulses.
 - c. Touching the silence control icon silences audible tone and causes icon to light steadily. After perimeter system is reset, operating the panel reset control icon extinguishes alarm icon.
28. Override of Normal Control for Operation of Exhaust Fans:
 - a. Touching the exhaust fan control icon starts designated fans for an operating cycle of programmable duration. Fans turn off automatically at end of cycle.
 - b. Indications: Yellow status icon lights steadily when fans are on; otherwise, icon is not lighted.
29. Water-Flow Control: On-off control icon at control panel for designated [showers] [fixtures] [showers and fixtures].
 - a. Touching the water-on control icon opens solenoid valve in supply line. Touching the control icon again closes valve.
 - b. Indications: Yellow icon is lighted when water is on; otherwise, icon is not lighted.
30. Trouble Alarm Indications for Auxiliary and Utility Systems: Include a separate status icon for each monitored alarm condition:
 - a. Monitored Conditions:
 - 1) Failure of normal electrical utility supply.
 - 2) Malfunction of generator set and standby power supply.
 - 3) UPS malfunction.
 - 4) Compressed-air system malfunction.
 - 5) HVAC system malfunction.
 - 6) Network malfunction.
 - 7) Controller fault.
 - b. Red alarm icons are normally not lighted. When failure or malfunction occurs, icons flash and alarm tone pulses.
 - c. Depressing the silence control icon silences audible tone and causes icon to light steadily. After alarm condition is corrected, operating the reset control extinguishes alarm icon.
31. Panel Control-Power Switch: Key-operated switch turns power to control panel on and off and enables operation.
 - a. Indications: Green power-on status icon is lighted when panel is enabled; otherwise, icon is not lighted.

32. Remote-Panel Enable Control: Control icon turns control power on and off for <Insert designation of satellite control panel>.
- a. Indications: Green icon is lighted when satellite panel is enabled; otherwise, icon is not lighted.

2.5

TOUCHSCREEN VIDEO CONTROL SOFTWARE

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Description: Custom developed from a detention application package[, and commercially available through a distributor network].
- C. Features and Functional Performance Requirements:
 1. Programmed to provide features and functional performance indicated without use of proprietary software code.
 2. Automatic alignment and adjustment of touchscreen interface with video monitor and its graphics.
 3. Visual and Audible Presentations: Designed for simplicity and rapid operator orientation, and conducive to operator focus on the highest-priority mission functions assigned to operator and station.
 4. Maps: Facility floor and site plans presented in selectable, scaled, on-screen, part-plan increments with the following content:
 - a. Basic architectural elements depicted with white lines on a black background.
 - b. Floor plan features for which control icons or status indicators are specified, including doors, gates, intercom stations, paging speakers, video cameras, duress stations, fire alarm stations, smoke detectors, and similar items.
 - c. Egress paths.
 - d. Control icons represent switches for specified control functions, operating through integration with the touchscreen interface.
 - e. Indicator icons show status of related feature by changing from nonlighted to lighted, by flashing, and by changing color.
 5. Priority Level Implementation: For processing and registering alarms, device signals, and intercom activity in the following order:
 - a. Fire and other life-safety alarms.
 - b. Staff-duress alarms.
 - c. Inmate sound-level monitoring alarms.
 - d. Door-monitoring and perimeter-security alarms and trouble signals.
 - e. Intercom calls from other master stations.
 - f. Intercom calls from access and inmate-movement control stations.
 - g. Intercom calls from cells.
 - h. System and equipment derangement and trouble alarms.
 6. Access Protection: Log-on passwords provide [16] <Insert quantity> levels of security for access to various functional capabilities provided at each touchscreen station. System shall support [1000] <Insert quantity> users.
 7. On-Line Utilities: Accessed through utility icons or menu items on screen and providing the following capabilities:
 - a. Configures, generates, and prints reports, using automatically logged event data.
 - b. Edits and updates programs, databases, system operating variables, point descriptions, help and operating protocol screens, and icon designations.
 - c. Operator Assistance Material: Provides interactive help messages and other material, including the following:
 - 1) Descriptions of functions initiated by control icons and menu items.

- 2) Explanations of conditions denoted by audible and visual indications.
 - 3) Instructions for performing control process.
 - 4) Synopses of policies governing control panel operation and standard operating procedures.
8. Audible Tones: Multiple computer-generated tones that can be programmed for frequency, volume, duration, and repetition rate and selected for each audio annunciation application.
- D. Telephone Technical Support: Unlimited technical support to respond to user questions about hardware and communication link troubleshooting, reconfiguring, and adjusting.
1. Telephone Calls: Toll free.
 2. Availability: 24 hours per day, 7 days per week.
 3. Responder Qualifications: Engineer or technician familiar with detention monitoring and control equipment.

2.6 TOUCHSCREEN LAN FILE SERVER

- A. Description: IBM-compatible microcomputer configured as a network file server. Minimum features, components, and capabilities shall be same as specified for touchscreen video control panel CPU, with the following exceptions:
1. [Redundant, Hot-Swappable,]Fixed-Disk Drives: <Insert capacity in gigabytes or terabytes>.
 2. [Redundant]Power Supply: 225-W rating.
 3. Expansion Slots: Four.
 4. Internal Backup Tape Drive: <Insert type and capacity in gigabytes or terabytes.>
 5. Network Interface Cards: Matched to network protocols, operating systems, and media.
 6. Network Operating System: <Insert proprietary system.>
 7. Peripheral Components:
 - a. Keyboard: <Insert system>.
 - b. Mouse: [Two] [Three]-button model
 - c. Monitor: 9 inches (228 mm), monochrome.

2.7 ADMINISTRATIVE MANAGEMENT COMPUTER

- A. Description: IBM-compatible microcomputer housed in [a standard tower enclosure] [an industrial chassis]. Minimum features, components, and capabilities shall be same as specified for touchscreen video control panel central-processing unit, with the following exceptions:
1. Peripheral Components:
 - a. Keyboard: <Insert system>.
 - b. Mouse: [Two] [Three]-button model.
 - c. Monitor: [17 inches (432 mm)] <Insert size>. With [1280 by 1024] <Insert number> resolution.
 - 1) On-Screen Colors: [256] <Insert number>.
 - 2) Video Card Capacity: <Insert capacity in megabytes>, VRAM with capture.
 - d. Speakers: Two amplified computer speakers.
 - e. Printer: Comply with "Printer" Article.
- B. Operational Performance: Same as specified for touchscreen video control panel with the following exceptions and additions:
1. On-Screen Switching and Selection Functions: Performed by mouse-initiated pointing and clicking instead of by touching the screen.
 2. Station Capability:

- a. Can assume the detention monitoring and control functions of any other touchscreen[or any graphic] control panel.
- b. Can assign the functional performance of any other touchscreen[or any graphic] control panel to any other touchscreen control panel.
- c. Configures, generates, and prints administrative and activity reports, using automatically logged event data.
- d. Edits and updates programs, databases, system operating variables, point descriptions, help and operating protocol screens, and icon designations.
- e. Edits maps.

2.8 PORTABLE PROGRAMMING COMPUTER

- A. Description: IBM-compatible laptop unit with internal high-speed network interface and the following additional minimum features and capabilities:
 1. CPU Speed and Capacity: <Insert processor speed and cache capacity.>
 2. RAM: <Insert capacity in gigabytes and memory type.>
 3. Fixed-Disk Drive: <Insert capacity in gigabytes.>
 4. CD-ROM Drive: [24] <Insert number> X.
 5. Floppy Disk Drive: One, 3-1/2 inches.
 6. Network Interface Cards: Matched to protocol and media used for PLC network.
 7. Modem: Internal, <Insert modem speed in kilobytes per second>.
 8. Operating System: <Insert proprietary network-compatible system.>
 9. Sound Card: <Insert bit speed and type of card.>
 10. Internal Speakers: Two.
 11. Ports: One parallel, two serial.
 12. Display: 12-inch (305-mm) active matrix.
 13. Cables required for programming and troubleshooting connections.
 14. Spare battery and external battery charger.
 15. Protective Case: Permanent, fitted unit with space for cables, and carry handle.

2.9 PLC SYSTEM

- A. General-Purpose PLCs:
 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. "Proprietary" PLCs Designed Specifically for Detention Facility Application:
 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- C. Description: Modular, generic PLCs manufactured for, and in general use in, general-purpose industrial applications; complete with controllers, power supplies, I/O modules, communication links, and housings. Features and functionality include the following:
- D. Description: Modular, general-purpose PLCs manufactured specifically for detention facility applications; complete with controllers, power supplies, I/O modules, communication links, and housings. Minimum features and functionality include the following:
 1. Characteristics: Adequate memory, software, I/O connections, communication capabilities, power capacity, and logic and timing functions to meet indicated requirements.
 2. Controller and I/O Uniformity: Manufacturer's different models shall be compatible, sharing common mounting centers, commands, control language, instruction code, and I/O structure.
 3. I/O Modules: Same manufacturer as PLCs and applicable within the full range of manufacturer's controller models.

4. Controller Output Capacity: Adequate to drive local I/O within 50 feet (15 m) of controller without interface modules or additional power supplies. Adequate to drive remote I/O within 1640 feet (503 m) of controller using remote I/O interface modules and a high-speed data link.
5. Expandability: Include a minimum of [25] <Insert number> percent spare capacity and operational capability for future expansion without performance degradation.
6. Controller EPROM: Stores system application program, operating software, and fixed database.
7. Controller General-Purpose RAM: Provides operational memory and storage for operating database. RAM is backed up by lithium battery of adequate capacity for a 12-month outage.
8. Controller Communication Capability: Serial RS 232, RS 422, or RS 485, plus standard Ethernet LAN, using nonproprietary protocol and copper or optical fiber media.
9. Diagnostics and Failure Response: Controllers and associated I/O devices shall be self-monitoring and self-diagnostic. They shall also monitor their communication links. Failure of any type shall be indicated by LED on the unit, and occurrence of failure shall be communicated to applicable control panel, where it shall result in a failure indication. An analysis of failure shall be registered in PLC memory and shall be remotely software accessible.
10. Redundant Controllers: If installed to meet indicated reliability requirements, a failure of controlling PLC shall be sensed by the redundant unit, which shall assume control and transmit a controller malfunction signal within one second.
11. PLC and Local I/O Power Supply: Regulated dc unit located in the same rack enclosure as units it serves; with 24-V output. Include the following features:
 - a. Capacity: 150 percent of load.
 - b. Voltage Control and Protection: Remote sensing of voltage at load and internal overvoltage protection.
 - c. Fault Protection: Fuses and inherent design protect against short circuit and overload, including shorting of either leg of dc output to conductive material energized intentionally or through malfunction at 120 V.
 - d. Surge Protection: Protect the power supply and its I/O circuits in all modes of operation.
12. Automatic Battery Backup: Capacity to deliver total power-supply input full-load current within specification tolerances for four hours if normal power source fails. Backup circuit shall be arranged so no alarms, indications, control functions, or data are lost or degraded during transfer of source.
13. PLC and Local I/O Device Mounting: Rack mounting in ventilated enclosures.

2.10 DATA COMMUNICATIONS

- A. Touchscreen video control panels and PLCs shall communicate directly with each other via serial communication links.
- B. Touchscreen video control panels shall communicate via LANs as follows:
 1. Communication between Touchscreen Video Control Panels and PLCs: Via PLC LAN, using PLC network interfaces.
 2. Communication between Touchscreen Video Control Panels: Peer to peer, using a common peer-to-peer operating system and network.
 3. Touchscreen Video Control Panel Communication: Via a touchscreen LAN, control panel to control panel[and control panel to administrative workstation computer].
 - a. Touchscreen LAN: Interconnect touchscreen video control panels[and touchscreen LAN file server,] providing indicated reliability level, maximum response times, and the following additional features:

- 1) Hardware: Network interface components with self-diagnostic capability to identify causes of network malfunctions and describe appropriate remedial action in on-screen displays accessible at [administrative management computer] [touchscreen video control panels] [and] [hand-held portable programming computer].
- 2) Media: Redundant signal paths with automatic switching from normal to alternate signal paths in the event of normal path failure.

2.11 RELAYS

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Description: Plug-in, [electromagnetic] [solid-state electronic] [electromagnetic or solid-state electronic] units. Arrange in relay assemblies that have the following features:
 1. Fuse and SPD protection.
 2. Indicating LED for each relay.
 3. Optical isolation of input circuits to [1500] [2500] [7500] V.
- C. Rating: A minimum of [125] [150] percent of the inrush current of controlled device, but not less than 6 A.

2.12 PRINTER

- A. Dot Matrix: Tractor feed; 24 pin, with 32-kb minimum buffer.
- B. Laser: Capable of <Insert number> pages per minute minimum nominal printing rate in draft mode.

2.13 DEDICATED UPS

- A. Description: Single-phase units, rated 120 V, 60-Hz input and output, complying with requirements for UPS-type central battery inverters in Section 263323.11 "Central Battery Equipment for Emergency Lighting" and with the following:
 1. Capacity: Adequate to supply full connected load for a minimum of [four hours] <Insert required duration>.
 2. SPD: Comply with UL 1449. Provide let-through voltage of 300 V or less.
 3. Annunciation of UPS malfunction at control panel.
 4. Connected Loads: PLCs and I/O modules both local and remote; operating, control, and indicating power supplies for control panels; and <Insert UPS loads>.

2.14 COMPONENT ENCLOSURES

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Description: Metal cabinets, racks, and consoles, with welded frames, complying with UL 1610.
- C. Doors, Covers, and Other Access Provisions:
 1. Hinged Type: Flanged, with locks and nonremovable pins in hinges.
 2. Screw Covers: Secure with security fasteners of type indicated or, if not indicated, flat-head (countersunk) security fasteners.

3. Locks: Pick-resistant, flush-tumbler type; three-point latching device for hinged doors or covers with latch edge more than 24 inches (610 mm) long.
 4. Keys: Identical, unless otherwise indicated. Removable only when lock is locked.
- D. Seismic Hardening: Increase rigidity of frames with additional welding and grinding of seams and addition of gussets at corners. Reinforce mounting and attachment provisions to resist seismic forces.
- E. Mounting and Anchoring Provisions: Accessible only when doors or covers are open.[Comply with applicable seismic criteria.]

2.15 CABLES

- A. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum. Comply with requirements in Section 280513 "Conductors for Electronic Safety and Security."
- B. Balanced Twisted-Pair Cable Comply with [Section 271313 "Communications Copper Backbone Cabling."] [Section 271323 "Communications Copper Horizontal Cabling."] [Section 271313 "Communications Copper Backbone Cabling" and Section 271323 "Communications Copper Horizontal Cabling."]
- C. Optical Fiber Cables and Connectors: Comply with [Section 271323 "Communications Optical Fiber Backbone Cabling."] [Section 271323 "Communications Optical Fiber Horizontal Cabling."] [Section 271323 "Communications Optical Fiber Backbone Cabling" and Section 271323 "Communications Optical Fiber Horizontal Cabling."]
- D. Fiber-Optic Cables and Connectors: Factory fabricated, jacketed, low loss, glass type, multimode, step index, operating at 650 to 850 nm.
1. Strands per Cable: Two.
 2. Dimensions: 200-micrometer core diameter, 250-micrometer cladding diameter.
 3. Maximum Attenuation: Minus 12 dB/km at 850 nm, minus 6 dB/km at 850 nm.
 4. Minimum Modal Bandwidth: 160 MHz/km at 850 nm; 500 MHz/km at 1300 nm.
 5. Operating Temperature Range: Minus 40 to plus 80 deg C.
 6. Plenum Cable: Listed for use in plenums.
 7. Cable Connectors: Quick-connect, quick-disconnect ST couplers.

2.16 ACCESSORIES

- A. Interfaces with equipment specified in other sections include accessories, adapters, electronic interface units, and connections required for functional performance indicated.

2.17 SECURITY FASTENERS

- A. Description: Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
 2. Drive System Types: [Pinned Torx-Plus] [pinned Torx] [or] [pinned hex (Allen)].
 3. Socket Flat Countersunk Head Fasteners:
 - a. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
 - b. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
 4. Socket Button Head Fasteners:
 - a. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
 - b. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.

5. Protective Coatings for Heat-Treated Alloy Steel:
 - a. Zinc chromate, ASTM F 1135, Grade 3 or 4; for exterior applications and interior applications where indicated.
 - b. Zinc chromate with oil, ASTM F 1137, Grade 1, or black oxide; unless otherwise indicated.

2.18 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 078413 "Penetration Firestopping."

2.19 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
 2. Sealing Elements: [EPDM] [NBR] <Insert element> interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 3. Pressure Plates: [Plastic] [Carbon steel] [Stainless steel]. Include two for each sealing element.
 4. Connecting Bolts and Nuts: [Carbon steel with corrosion-resistant coating] [Stainless steel] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of detention monitoring and control system.
 1. Examine roughing-in for embedded and built-in anchors to verify actual locations of system connections before detention monitoring and control system installation.
 2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of detention monitoring and control system.
- B. Inspect built-in and cast-in anchor installations, before installing detention monitoring and control system, to verify that anchor installations comply with requirements. Prepare inspection reports.
 1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
 2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

- C. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEMS INTEGRATION

- A. Integrate installations and connections of equipment and systems specified in this Section with those specified in the following Sections:
 - 1. Section 087163 "Detention Door Hardware" for detention hardware controlled by detention monitoring and control system.
 - 2. Section 275123 "Intercommunications and Program Systems" for intercommunication and paging equipment.
 - 3. Section 284621.11 "Addressable Fire-Alarm Systems" and Section 284621.13 "Conventional Fire-Alarm Systems" for fire alarm equipment and devices.
 - 4. Section 283121 "Area and Perimeter Intrusion Detection" for detection devices.
 - 5. Section 282000 "Video Surveillance" for closed-circuit television equipment.
 - 6. Section 323113 "Chain Link Fences and Gates" for gate operators and locking devices.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Anchor equipment to building structural elements and support according to requirements in Section 270529 "Hangers and Supports for Communications Systems."
- C. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounted items.
- D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- F. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- G. Right of Way: Give to raceways and piping systems installed at a required slope.
- H. Security Fasteners: Where accessible to inmates, install detention monitoring and control components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials, except that a maximum of two different sets of tools shall be required to operate security fasteners for Project.[Provide stainless-steel security fasteners in stainless-steel materials.]
- I. Cybersecurity:
 - 1. Software:
 - a. Coordinate security requirements with [IT department] [CIO] <insert entity responsible for IT security>.
 - b. Ensure that latest stable software release is installed and properly operating.

- c. Disable or change default passwords to password using a combination of uppercase and lower letters, numbers, and symbols at least 8 characters in length. Record passwords and turn over to party responsible for system operation and administration.
- 2. Hardware:
 - a. Coordinate location and access requirements with [IT department] [CIO] <insert entity responsible for IT security>.
 - b. Enable highest level of wireless encryption that is compatible with Owner's ICT network.
 - c. Disable dual network connections.

3.4 GROUNDING

- A. AC Power and Lighting Circuits: Comply with Section 260526 "Grounding and Bonding for Electrical Systems" for materials and installation requirements.
- B. Class 2 Power - Limited Power, Signal, and Control Circuits: Ground systems and equipment according to manufacturer's written instructions.

3.5 WIRE AND CABLE INSTALLATION

- A. Low-Voltage Analog Circuits: Install wiring as specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Balanced Twisted-Pair Cabling: Install as specified in [Section 271313 "Communications Copper Backbone Cabling."] [Section 271323 "Communications Copper Horizontal Cabling."] [Section 271313 "Communications Copper Backbone Cabling" and Section 271323 "Communications Copper Horizontal Cabling."]
- C. Optical Fiber Cable: Balanced Twisted-Pair Cabling: Install as specified in [Section 271323 "Communications Optical Fiber Backbone Cabling."] [Section 271323 "Communications Optical Fiber Horizontal Cabling."] [Section 271323 "Communications Optical Fiber Backbone Cabling" and Section 271323 "Communications Optical Fiber Horizontal Cabling."]
- D. Bundle, train, and support wire and cable in enclosures.
- E. Connections: Make connections according to manufacturer's wiring diagrams, unless otherwise indicated.
- F. Wiring Method: Install wire and cable in metal raceway except where another wiring method is indicated.

3.6 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 078413 "Penetration Firestopping."
- C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

- E. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- I. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed[or unless seismic criteria require a different clearance].
- J. Seal space outside of sleeves with grout for penetrations of concrete and masonry[and with approved joint compound for gypsum board assemblies].
- K. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Section 079200 "Joint Sealants" for materials and installation.
- L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with Section 078413 "Penetration Firestopping."
- M. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- O. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.7 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Comply with requirements in Section 078413 "Penetration Firestopping."

3.9 IDENTIFICATION

- A. Identify electrical components and power wiring according to Section 260553 "Identification for Electrical Systems."
- B. Identify communications components and control wiring according to Section 270553 "Identification for Communications Systems."
- C. Label each monitoring and control module and equipment unit with a unique designation that is consistent with wiring diagrams and schedules in operation and maintenance manual. Label conductors and cables at each end and where exposed within troughs and pull-and-junction boxes.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections[with the assistance of a factory-authorized service representative]:
 - 1. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
 - 2. Inspect detention monitoring and control components for defects and physical damage, labeling of testing laboratory, and nameplate compliance with the Contract Documents.
 - 3. Inspect interiors of enclosures, including the following:
 - a. Integrity of mechanical and electrical connections.
 - b. Component type and labeling verification.
 - c. Ratings of installed components.
 - 4. Electrical Tests: Use caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
 - a. Continuity tests of circuits.
 - b. Operational Tests: Set and operate controls at each control panel and at each monitored and controlled device to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Record response to each test command and operation, including logging and printout of events. Record time intervals between initiation of alarm conditions and registration of alarms at control (panel), and between initiation of commands and execution at controlled equipment.
 - 1) Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled and systems to be integrated with detention monitoring and control work.
 - 2) Simulate malfunctions to verify protective features and appropriate alarm indications.
 - 5. Seismic-restraint tests and inspections shall include the following:

- a. Type, size, quantity, arrangement, and proper installation of mounting or anchorage devices.
 - b. Test mounting and anchorage devices according to requirements in Section 270548.16 "Seismic Controls for Communications Systems."
 - 6. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
 - 7. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
 - 8. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, retests, and inspections. Include printout of testing event log, annotated to provide a machine record of testing that corresponds to written test records.
- D. Prepare test and inspection reports.

3.11 DEMONSTRATION

- A. [Engage a factory-authorized service representative to train] [Train] Owner's maintenance personnel to adjust, operate, and maintain systems. Refer to Section 017900 "Demonstration and Training."
- B. Video Training: Provide [two-copies] [on-demand] training covering features, capabilities, and operation of installed control panels. Illustrate actual equipment and related functions. Show cause-and-effect sequences during operation. Cross-reference instruction manuals throughout. Follow same order of presentation as instruction manual. Include the following:
 - 1. Control Panel Operation:
 - a. Describe and demonstrate indications, controls, and features.
 - b. Demonstrate responses to all indications, call-ins, and emergencies.
 - c. Demonstrate setup of control panels and related equipment.
 - d. Describe and demonstrate safety and security precautions.
 - e. Show how to get help.
 - 2. System and Equipment Maintenance:
 - a. Describe and demonstrate safety and security precautions.
 - b. Demonstrate basic maintenance; need for qualified technician for internal maintenance; basic maintenance schedule; techniques for keeping terminals properly tightened, filter screens clean, and overheat sensors checked; and techniques for performing other required servicing.
 - c. Demonstrate adjustment of controls. Describe warranty and show how to get help.
 - 3. System Troubleshooting:
 - a. Demonstrate troubleshooting procedure for common software, programming, control panel, communications, and field device problems.

3.12 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: When requested by Owner, within one year of date of Substantial Completion, provide a minimum of [three] <Insert number> Project-site visits to adjust and calibrate components, to make programming adjustments and revisions, and to assist Owner's personnel in making program changes and in adjusting equipment and controls. Provide up to [80] <Insert number> hours of services, exclusive of travel time, for these purposes.[Occupancy adjustment visits as specified here shall be in addition to any required by warranty.]

- A. Panel Designation: <Insert drawing designation.>
- B. Type of Panel: [Hard membrane switch] [Hard electromechanical switch] [Touchscreen].
- C. Configuration of Switches and Other Components on Panel: [Graphic] [Tabular].
- D. Controls, Visual Status Indicators, and Other Features: Include the following in addition to indicators specified as associated with controls in Part 2:
 - 1. Door[and Gate] Controls and Indications:
 - a. Individual Lock and Unlock Door Controls for Non-Cell Doors: <Insert door designations.>
 - b. Individual Lock and Unlock[, Group Assign] Controls and Visual Status Indicators for Doors: <Insert door designations.>
 - c. Individually Controlled Cell Door Controls: <Insert designations of cells.>
 - d. Controls for Mechanical Operation of Power-Operated [Doors] [Gates] [Doors and Gates]: [Open and close] [Open, stop, and close] control for <Insert door and gate designations>.
 - e. Status Indications for Each Controlled Door[and Gate]: Nonsecure[and secure].
 - f. Controls and Visual Status Indications for Interlocked Door Groups: <Insert designation of each group and identify doors in group.>
 - g. Override control for each interlocked door group.
 - h. Controls for Doors with Group and Individual Control Option: <Insert designations of spaces or doors.>
 - i. Controls for Group Locking and Unlocking of Doors: <Insert each group designation and designations of doors assignable to the group.>
 - j. Control for Assigning Doors to a Group for Locking and Unlocking: <Insert each group designation and designations of doors assignable to the group.>
 - k. Abort Control for Automatic Fire-Door Release Function:
 - 1) Countdown indicator for egress doors.
 - 2) Countdown indicator for cell doors.
 - l. Inmate Access Enable and Disable Controls: <Insert designation of each control and identify cell doors it controls for inmate access.>
 - m. Individual Status Indications for Doors with Status Indications Only at Panel (No Lock and Unlock Control): <Insert door numbers.>
 - 2. Audio Controls and Visual Indications: Include the following:
 - a. Intercom Station Controls and Indications: <Insert station designation for each station controlled.>
 - b. Paging Zone Controls and Indications: <Insert zone designations.>
 - c. Audio Threshold Monitoring Controls and Indications: <Insert designation of each control and identify associated intercom stations and other sensors, if any, to be monitored.>
 - 3. Video Controls and Indications: Include the following.
 - a. Controls for Manual Selection of Individual Cameras for Monitor Viewing: <Insert designations of cameras switchable to monitor at control panel.>
 - b. Visual indications identifying camera switched to spot monitor.
 - c. Automatic Camera Selection: <Insert designations of cameras and intercom stations and other functions and devices associated with automatic switching.>
 - 4. Lighting, Power, and Miscellaneous Controls and Indications:
 - a. Cell Lighting Control: <Insert designations of cells with lights individually controlled from panel.>
 - b. Cell Lighting[and Power] Inmate-Access Control: <For each control, insert designations of cells that may be enabled for inmate access to light switching.>

- c. Receptacle Control: <For each control, identify receptacles controlled or insert designations of spaces that have all receptacles in the space controlled.>
- d. Night Lighting Controls: <For each control, insert designations of spaces for which night lights are controlled.>
- e. Day-Room Lighting Controls: <For each control, insert designations of day rooms controlled.>
- f. Other Lighting Controls: <Insert designations of other areas with panel control of lighting.>
- g. Day-Room Television Receptacle Controls: <For each control, insert designations of day rooms controlled.>
- h. Cigarette Lighter Controls: <For each control, insert designations of spaces with panel control of cigarette lighter outlets.>
- i. Water-Flow Controls: <For each control, insert designations of fixtures controlled or of spaces with water-flow control.>
- j. Exhaust Fan Control: <Insert designations of spaces and fans controlled.>
- k. Smoke Control: <Insert designations of spaces involved in smoke-control operating mode.>
- 5. Fire Alarm Indications:
 - a. General fire alarm.
 - b. Smoke Detectors: <Insert detector designations or descriptions of areas.>
 - c. Smoke Detector Zones: <Insert zone designations.>
 - d. Sprinkler Flow: <Insert designations of flow devices or descriptions of areas.>
 - e. Manual Stations: <Insert designations or descriptions of areas.>
- 6. Duress-Alarm Indications:
 - a. Individual alarm indications for each duress [zone] [station] in <Insert designations or descriptions of areas>.
- 7. Perimeter-Security-Alarm Indications:
 - a. Individual alarm indication for each detection zone in <Insert designations or descriptions of areas>.
- 8. Elevator Controls and Indications:
 - a. Secure and access switches and status indications.
 - b. Door lock and unlock control.
 - c. <Insert descriptions of alternative controls and indications required.>
- 9. HVAC System Status Indications: For <Insert designations for systems or equipment monitored by panel>.
 - a. Normal Operation Indications: For each system.
 - b. Malfunction Indications and Alarm: For each system.
- 10. Trouble Alarm Indications for Auxiliary and Utility Systems: Audible and visual indications that will provide a single nondifferentiated alarm for any of the following malfunctions:
 - a. <Insert list of malfunctions and trouble conditions to be included.>
- 11. Trouble Alarm Indications for Auxiliary and Utility Systems: Audible and visual indications that will provide a separately identified alarm for each of the following malfunctions:
 - a. <Insert list of malfunctions and trouble conditions to have separate indications.>
- 12. Acknowledge control for intercom call-in.
- 13. Microphone for intercom and paging.
- 14. Voice handset for intercom and paging.
- 15. Push-to-talk control for microphone.
- 16. Digital clock.
- 17. Lamp test control.
- 18. <Insert required items.>

- E. Touchscreen Map Requirements: Include the following maps:
1. Floor Plan of [Spaces in Immediate Vicinity of Control Panel] <Insert description of area>: Include locking and unlocking, intercom, and audio and video features.
 2. Floor Plan of [Spaces in Immediate Vicinity of Control Panel] <Insert description of area>: Include lighting and power and HVAC features.
 3. Floor Plan[of Spaces in Immediate Vicinity of Control Panel]: <Include duress alarm, fire alarm, and local perimeter-security alarm.>
 4. Floor Plan of Facility: Include elevator, generator set, and UPS features.
 5. Facility Site Plan: Include perimeter detection and related features.
- F. Duplicates of Maps Indicated for Other Touchscreen Video Control Panels: Include functions for which this panel may require control or indication.

END OF SECTION